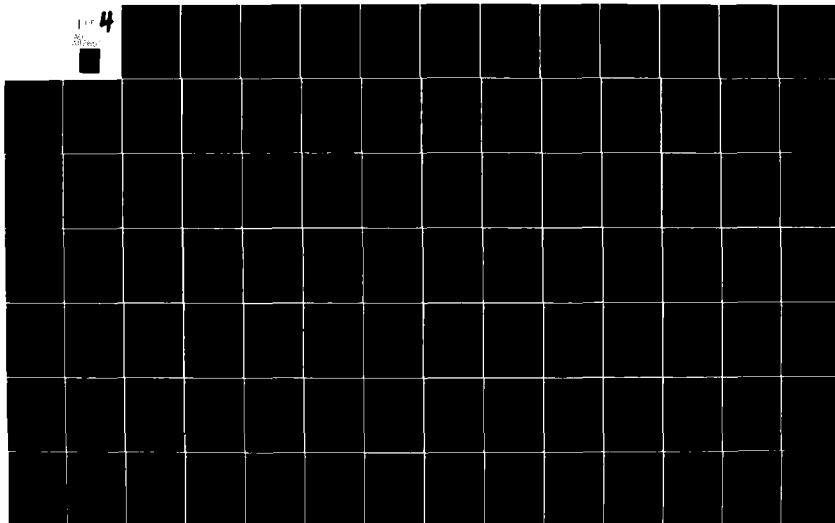
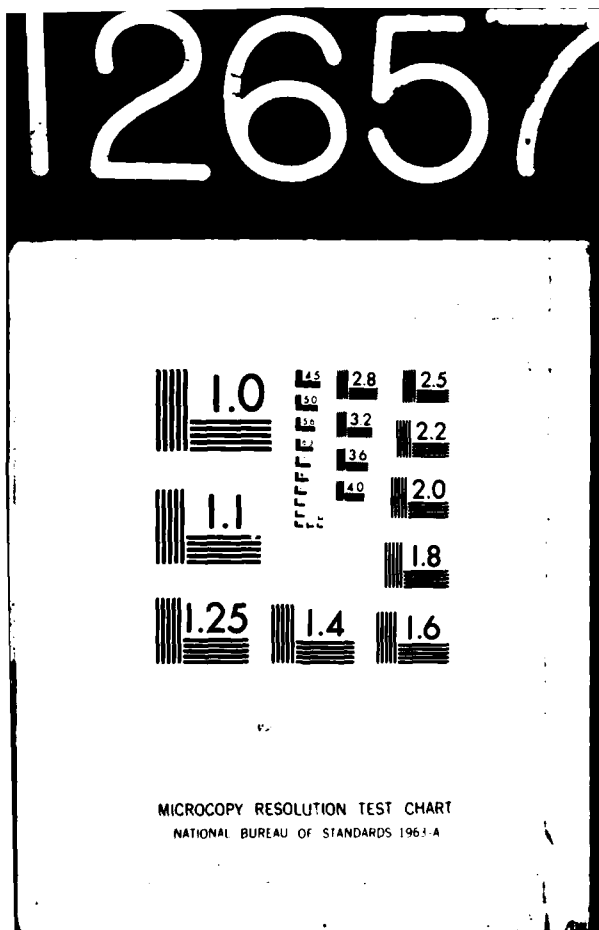


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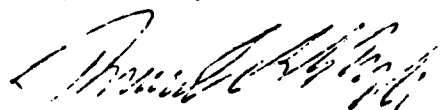
Technical Report TR 8-76
July 1976

Directorate of Combat Operations Analysis
US Army Combined Arms Combat Developments Activity
Fort Leavenworth, Kansas 66027

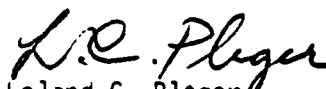
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PROGRAMMER/ANALYST MANUAL

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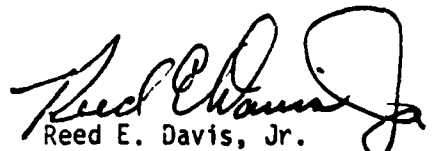
Approved by:



Thomas E. deShazo, Jr.
Colonel, FA
Chief, War Games Division



Leland C. Pleger
Technical Director



Reed E. Davis, Jr.
Colonel, IN
Director

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CHAPTER 9

TACTICAL FIRE DIRECTION SYSTEM MODEL

1. **MILITARY ACTIVITY REPRESENTED.** The Tactical Fire Direction System (TACFIRE) Model represents the scheduling of nonnuclear area fire munitions by cannon systems, missile systems, and multiple rocket launchers. The aspects modeled include the fire planning, target analysis, fire direction, and fire support coordination functions inherent in the employment of field artillery. The tactical fire direction and coordination capabilities of the division TACFIRE system are also represented within the model.

2. **MODEL DESIGN:**

a. **Fire Units in the TACFIRE Model.** Fire units used in the model may be at a battalion or at a battery level of resolution, at the user's discretion. Each fire unit may contain up to four area fire weapon/ammunition combinations, although only one combination can be used for one fire mission. TACFIRE controlled missions are fired as full unit volleys. The number of rounds or rockets fired per volley is equal to the number of integral tubes or launchers. In the TACFIRE mode each division is allowed a maximum of 36 fire units. For each weapon system defined there is also defined a corresponding munition load representative of the munitions delivered by the weapon system. In the case of a multiple rocket launcher weapon system firing multiple rounds in a small time interval, the equivalent round is the total number of rounds fired during the interval.

b. **TACFIRE Scheduled Fires.** Fire missions against targets of opportunity are represented in the TACFIRE Model. These targets represent targets that have not been previously considered, analyzed, or planned, and usually are expected to be fleeting in nature. The TACFIRE Model is patterned after the division TACFIRE system and is based on reference material obtained from the Functional System Design Requirements Study for TACFIRE (Reference 1). Fire mission requests are generated in the Intelligence and Control Model after the targets have been detected and a target analysis performed. Details of this process are specified in the Intelligence and Control Model discussion in Chapter 6 of this section. All fire units within a division that are given either stay orders or no order at all are available for assignment by the TACFIRE Model routines. The macroflow of fire missions into, through, and out of the TACFIRE Model is shown in Figure IV-9-1.

(1) **Specific Target Types.** Specific fire missions considered in the TACFIRE Model include counterbattery fires, supporting fires fired at the request of maneuver units engaged in ground combat, and fire missions fired at targets detected by UGS fields and radar detection systems and reconnaissance missions. The targets developed in the Ground Combat Model correspond to direct support (DS) requests. Within the model a maximum of two DS fire units is allowed for each maneuver brigade/regiment. Identification of DS requests and fire unit selection are discussed in the submodel specifications.

(2) **Forces Without TACFIRE.** Each division has a TACFIRE system capability within the model. To represent divisions without such a capability, the model input parameters representing the response time required to fire

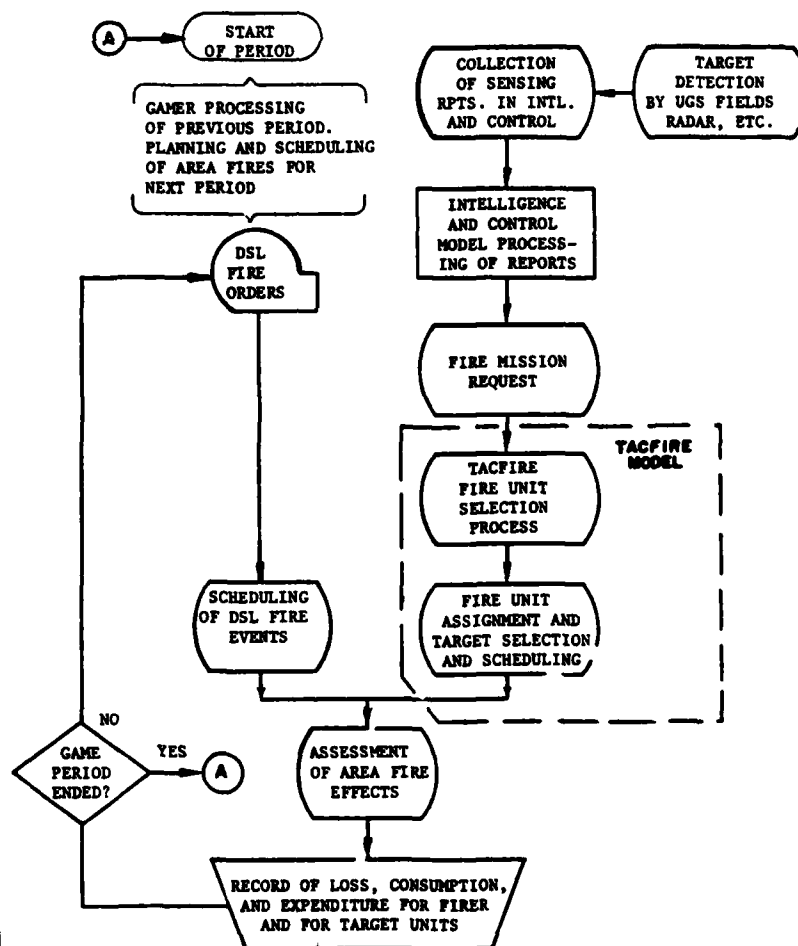


Figure IV-9-1. TACFIRE Model Macroflow

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DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	<i>on file</i>
By _____	
Distribution/	
Availability Codes	
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the initial volley of a fire mission for each type of fire unit can be increased to allow for lack of coordination and for slower tactical and technical fire direction procedures. This assumption has been used in the TACFIRE Cost Effectiveness Study (Reference 2).

(3) TACFIRE Target Priorities and Fire Unit Selection Control. To model the fire unit selection process and the selection of targets from a priority list, the TACFIRE Model requires, as input data, target priority tables and method of attack tables.

(a) Target Priority Tables. The target priority tables represent the division commander's priority considerations for selecting targets and assignment of fire missions. The priority scale is limited to integer values between one and four, with priority one having the highest priority. The four target priorities based on their relative military worth as defined in FM 6-20 and used in studies such as Legal Mix III (Reference 8) can be used. If added resolution of target priorities is required, a larger number of priority categories could be implemented. These target priorities, regardless of the categories used, are based on considerations of the target analysis estimated parameters: size, activity, type, and proximity to maneuver units. These parameters are fully described in the submodel specifications of the routine AFTFCL. Although the priority assigned to a target is a division priority, it will not restrict a brigade commander from using DS fire units on what may be lower priority targets.

(b) Method of Attack Tables. The method of attack tables provide the model with input data describing the choice of weapon systems in order of preference for employment against a target and the level of attack to use against the target. No massing of fire units is allowed, but the number of volleys desired from a single fire unit against a given target is specified as input data in the method of attack table. A detailed description of the attack tables and their use in the fire unit selection process is given in the submodel specifications section.

(c) Fire Direction Control Arrays. The TACFIRE Model routines maintain a complete record of the status of each fire unit in the division. This fire unit status record, together with division target list information, is used to select fire units for fire missions in accordance with the target priority assignments and method of attack information provided as indirect gamer model control data. Thus, each division has a tactical fire direction center simulated within the model structure.

e. Scheduling of Volleys. The scheduling of fire events within the model occurs for each volley fired in every fire mission. The time lapse between the target entering the TACFIRE Model and the first volley fire event of the fire mission is the total response time expected for a typical fire unit composed of the particular weapon system type selected for the mission, and includes an average TACFIRE capability response time, technical fire direction response time, and average time of flight of the rounds. The scheduled time of the fire event is the impact of the volley within the target area. The parameters used in time sequencing the volleys are the weapon firing rates provided in the input data. Identical time parameters

are used to schedule the volleys, regardless of whether the fire mission is in response to a DSL fire order or a TACFIRE request. All assessment events occur immediately following the impact events.

d. TACFIRE Model Interaction with other models. The TACFIRE Model interacts directly with the Area Fire Model, the Intelligence and Control Model, and the Suppression Model.

(1) Intelligence and Control Model Interactions. The interactions of the TACFIRE Model with the Intelligence and Control Model occur through the fire mission requests sent to the TACFIRE Model. The interface between the two models is achieved in the division target list.

(2) Area Fire Model Interactions. The fire missions scheduled by the TACFIRE Model are subsequently fired by the Area Fire Model that simulates the delivery of and assessment from each volley of fire.

(3) Suppression Model Interactions. Fire units are not permitted to accept or fire a fire mission during the period of time they are suppressed by enemy fire. The suppression times are scheduled by the Suppression Model.

3. SUBMODEL SPECIFICATIONS:

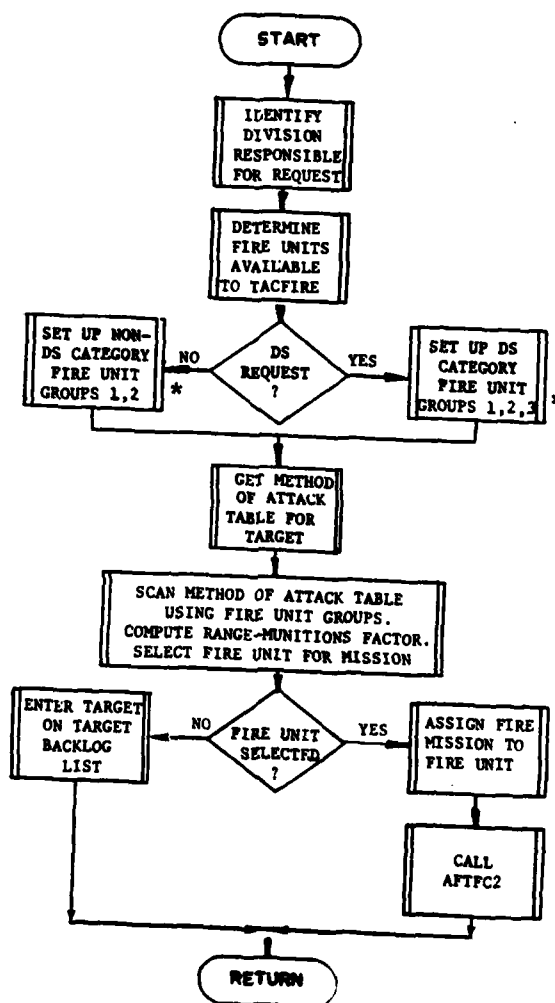
a. The submodels of the TACFIRE Model are represented in the Period Processor of the DIVWAG system by the routines AFTFC1 and AFTFC2. The technical aspects of both of these routines as they relate to the planning, allocation, and scheduling of artillery fire support are described in following subparagraphs.

b. The area fire tactical fire control is composed of two sections. Section 1 (routine AFTFC1) assigns fire missions to selected fire units. Section 2 (routine AFTFC2) is designed to represent the target selection process when a backlog of targets exists and a fire unit becomes available for a fire mission.

(1) Area Fire Tactical Fire Control, Section 1 (AFTFC1). This routine receives fire mission requests from the Intelligence and Control Model, selects fire units, and assigns fire missions to these fire units. A macroflow of the routine is illustrated in Figure IV-9-2.

(a) TACFIRE Fire Mission Requests. The Intelligence and Control Model sends fire mission requests to AFTFC1. The fire mission requests contain the following target intelligence information and model processing information:

- . Identity of the unit detecting the target
- . Identity of the unit requesting the fire mission
- . Sensing report number
- . Identification of the target unit
- . Estimated target type
- . Estimated target size
- . Estimated target activity



* See definition, paragraph (d)1b, page IV-9-8

Figure IV-9-2. AFTFC1 Macroflow

- . Estimated rate of movement
- . Estimated direction of movement
- . Time the target was last detected
- . Identification of redundant fire mission requests

The target estimated type is identified as one of the following:

- . 1 - Infantry
- . 2 - Armor
- . 3 - Mechanized infantry
- . 4 - Reinforced task force
- . 5 - Tube artillery
- . 6 - Missile artillery
- . 7 - ADA guns
- . 8 - ADA missiles
- . 9 - Air base
- . 10 - Engineer
- . 11 - Command post

Estimated target activity is specified as:

- . 1 - Inactive
- . 2 - Move
- . 3 - Fire
- . 4 - Engineer
- . 5 - Attack
- . 6 - Defend
- . 7 - Withdraw

Estimated target size categories are specified as:

- . 1 - Platoon-size target
- . 2 - Company-size target
- . 3 - Battalion-size target
- . 4 - Greater than battalion-size target

(b) Division Target List Information. The target information received in the fire mission request is stored on the division's target list. The target list contains all the fire mission requests pending within the division's zone of responsibility. Information stored on the target list includes the following:

- . Record number of target unit on unit status file (USF)
- . Latest sensing report number
- . Estimated X coordinate
- . Estimated Y coordinate
- . Estimated rate of movement
- . Estimated direction of movement
- . Time of last detection

- . Combined target activity, size, type index
- . Identification of echelon of unit requesting the fire mission
- . Identification of unit requesting the fire mission
- . USF record number of DS units if this is a direct support request
- . USF record number of the nearest friendly maneuver unit
- . Target priority
- . Time when fire mission was received in AFTFCL.

Each divisional center is allowed a maximum of 48 pending fire mission requests. If an additional request is received when the list is full, the target with the lowest priority is dropped from the list and the new one is added.

1. Stationary targets remain on the target list until the fire mission request has been completed or until an updated fire mission request supersedes the previous target intelligence. The updated information is retained, and the old target information is deleted.

2. Moving targets are subject to the same conditions as stationary ones with the exception of a time limit that is imposed on the target's time on the target list. If the target is estimated to have moved at least 3000 meters based on the latest estimated rate and time of last detection, it is dropped from the target list.

3. Every target received by AFTFCL is assigned a target priority based on the target's estimated type, size, activity, and proximity of the target to the nearest friendly maneuver unit. For each combination of target type and activity, three range categories are defined, and priorities within these range categories are established as part of the data preparation phase. The priority value scale can range from one to four, with only integer values allowed and one denoting the highest possible priority. The submodel identifies the range category by locating the front line maneuver unit that is closest to the target. The separation between the maneuver unit and the target is used to determine the range category.

(c) Division TACFIRE Fire Unit Status Record. The status of each fire unit within a division's TACFIRE system is maintained on the division fire unit status record (FUSRCD). Information maintained includes the following:

- . USF record number of fire unit
- . Fire unit mission code (DS=1, REINF=2, GS/REINF=3, GS=4)
- . Fire unit pending order code
- . Weapon equipment item code
- . Maximum range of weapon
- . Minimum range of weapon
- . Weapon/munition combination index (for each munition)
- . Available supply rate (ASR) priority cutoff (for each munition)
- . ASR (for each munition)
- . Fire unit's mission assignment code

- . Number of volleys assigned in present fire mission
- . Number of volleys fired in present fire mission
- . Number of rounds in each volley of current fire mission
- . Weapon/ munitions combination used in fire mission
- . Scheduled end time of present fire mission
- . Target aim point (X, Y) coordinates

(d) Fire Unit Selection Process Logic. The selection of a fire unit to execute a fire mission request is determined by combining several selection criteria to represent current availability of fire units, on-hand supply of munitions for candidate fire units, organizational mission responsibilities of fire units (i.e., GS, GS/REINF, REINF, and DS), range to target, and weapon/munitions effectiveness. This information is combined by the logic in APTFCL. The selection process used is representative of situations where a new target has been received in the system and several fire units are available for the possible assignment to the mission.

1. The available fire units initially listed are those fire units that are: (1) in the TACFIRE mode, (2) within maximum and minimum range limits of the target, and (3) currently not assigned a fire mission. This set of available fire units is further subdivided into priority of selection groups dependent upon the fire mission request categories recognized by the model. These fire mission request categories are either DS fire mission requests (DS category) or other fire mission requests (non-DS category).

a. Fire missions categorized as DS requests are identified as all fire mission requests originating in maneuver battalions or brigades/regiments. For each DS request, the DS artillery fire unit(s) assigned to the maneuver brigade/regiment are identified and stored. All other fire mission requests belong to the non-DS category.

b. In the selection process for the DS category, all available fire units are grouped in order of possible consideration for fire mission as follows:

- . Group 1 - Unit or units in DS of battalion or brigade/regiment requesting fire mission
- . Group 2 - All available GS, GS/REINF, REINF units
- . Group 3 - All other available DS units, where availability is defined as before.

c. The grouping for the non-DS category in order of possible consideration for fire missions is as follows:

- . Group 1 - All available GS, GS/REINF, and REINF units
- . Group 2 - All available DS units.

2. Before the selection process can begin, the weapon/ munition effectiveness and/or choice of weapon preference must be specified. These items are supplied in the pregame data preparation of the method of

attack tables. Each specific target combination considered has a method of attack table specifying the weapon/munitions combinations, in order of preference, and the level of attack. A typical method of attack table is shown in Figure IV-9-3.

a. Within the method of attack table the weapon/munition combinations for potential employment against the target are listed in order of preference. This preference should be based on the effectiveness of the systems as derived in studies such as Legal Mix IV (Reference 3), TACFIRE Requirements Study (Reference 1), FM 6-141-1 (Reference 5), Munition-Target Relationships Study (Reference 6), and on the particular scenario or doctrinal concepts applicable to the particular game situations being considered.

b. The level of attack is the number of full fire unit volleys required in the fire mission to attack the target and is likewise subject to conditions considered in the above preference.

3. Once the target's method of attack table is identified and the fire unit grouping established, the selection process initiates a scan of the method of attack table in order of the preference indicated.

a. The first choice in the table will identify the preferred first choice of weapon system type and munitions to be used. If a fire unit with this weapon munition combination is available in Group 1 the fire unit is assigned if it has adequate munitions.

b. If several candidate fire units in Group 1 have the weapon/munition combination, a munitions-range workload factor is computed as follows for each candidate fire unit:

$$F_{MR} = N_R^i \frac{R_{MAX} - R_{TGT}}{R_{MAX} - R_{MIN}} \quad (IV-9-1)$$

where:

- F_{MR} = munitions-range workload factor
- N_R^i = number of rounds of the munitions type specified for this weapon/munition combination
- R_{MAX} = maximum range of weapon/munitions combination
- R_{MIN} = minimum range of weapons/munitions combination
- R_{TGT} = range to target.

The fire unit with the largest munitions-range workload factor is selected from the candidates for fire mission assignment.

TARGET INTELLIGENCE INFORMATION:									
Estimated type	(2) ARMOR								
Estimated activity	(2) MOVE								
Estimated size	(5) BATTALION								
Method of Attack	Weapon/Munition Preference								
	1	2	3	4	5	6	7	8	9
Weapon/munitions combination index	11	10	9	3	7	6	5	4	8
Weapon index	92	48	20	46	83	90	83	42	85
Munitions index	93	51	22	47	84	91	84	43	86
Level of attack, number of fire unit volleys	1	1	2	4	8	8	8	8	5

Figure IV-9-3. Method of Attack Table

c. If no fire units are available within the group with the weapon/munition first choice preference, or if adequate munitions are not available for the first choice preference, the next choice in the method of attack table is checked using the same logic. This process continues until a fire unit within Group 1 has been selected or until the choices in the method of attack table have been exhausted.

d. When all choices have been exhausted in the method of attack table for Group 1 fire units, and no fire unit has been selected, Group 2 fire units are identified; and the attack table is again scanned beginning with the first choice and continuing as before. This procedure continues until a fire unit is selected or until the last group is processed.

4. The hierarchy of the selection process can be summarized in terms of the competing selection factors arranged in the order in which they are applied.

- . Target or mission request categorization as DS or other requests
- . Fire unit mission grouping
- . Weapon/munitions preference or effectiveness
- . Munitions-range workload factor.

5. The selection of fire units is a dynamic process, and fire unit availability during the game period is a driving factor in determining the fire unit actually selected for the fire mission by the above logic scheme. Gamer control of fire unit selection within the TACFIRE mode occurs through DSL fire orders that render fire units unavailable while executing the DSL fire mission; through organizational assignment of DS, GS, GS/REINF, and REINF roles; through deployment or location of fire units; and through the initial preparation of method of attack tables and target priority tables.

6. If no fire units are available for an assignment, the target information is stored on the division's target list and will be processed again immediately after a fire unit becomes available. The logic process used when a target backlog exists is described in routine AFTFC2.

(e) Fire Mission Assignment. When a fire unit has been selected for a fire mission, the fire mission parameters on the method of attack table are set up in the fire unit status record (paragraph (c) above), and the fire unit processing is transferred to AFTFC2 for the individual scheduling of the volleys.

(2) Area Fire Tactical Fire Control, Section 2 (AFTFC2). Routine AFTFC2 is designed to represent the target selection process when a backlog of targets exists and a fire unit becomes available for a fire mission. The routine AFTFC2 generates fire missions from the target backlog list for those fire units that have completed fire missions or otherwise become available in the TACFIRE mode. AFTFC2 also generates the successive volleys for a fire unit currently engaged in a fire mission. Each time an active fire unit enters AFTFC2, its unit status record is used to update the information in the fire unit status record so that each volley assigned in a fire mission is subject to dynamic game sequencing. A macroflow of AFTFC2 is shown in Figure IV-9-4.

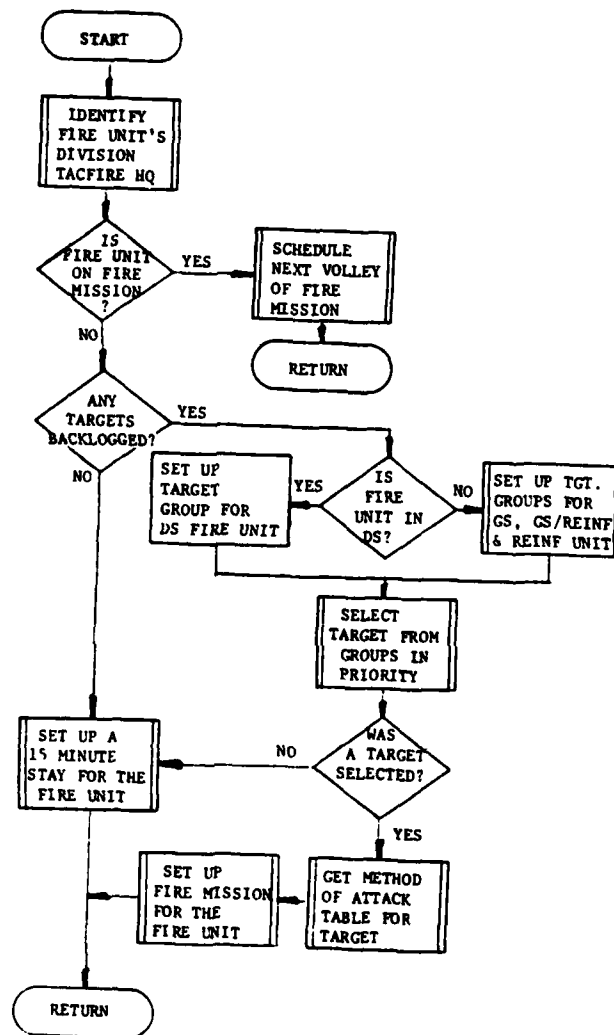


Figure IV-9-4. AFTFC2 Macroflow

(a) Fire Unit Activation. When a fire unit enters AFTFC2 after it has completed a fire mission or becomes available from a DSL fire mode or move mode, the division target list is checked for a target backlog. If there are no targets the fire unit TACFIRE range code eliminator is set to zero to indicate there are no targets in the system on which the fire unit can fire. The fire unit is then scheduled for a 15-minute stay in the TACFIRE mode but can be activated by a new target entering the system in AFTFC1.

(b) Target Selection Process. When a target backlog exists a scanning of the target backlog list is initiated, and candidate target selection information is stored in the target selection array. The target list is scanned in three different sequenced passes that generate priority target groups based on the fire unit's organizational mission (i.e., DS, GS, GS/REINF, or REINF role).

1. If the fire unit is in a DS role, the initial scan ignores all targets except those that have been identified as being requested by the maneuver brigade or battalion of which the fire unit has been placed in direct support.

2. If no targets are found in the initial scan or if the fire unit is not in a DS role, the scan of the target list is set to select all targets that are identified as DS fire mission requests.

3. All targets not previously considered in a DS scan are included in the last scan. Thus, for fire units in DS roles the target backlog is grouped into three mutually exclusive groups as viewed from the fire unit:

- . Group 1 - DS request for the fire unit being considered
- . Group 2 - DS request for other DS fire units
- . Group 3 - All other targets.

4. When a fire unit is in a GS, GS/REINF, or REINF role the targets are grouped into two mutually exclusive groups:

- . Group 1 - DS requests for all DS fire units
- . Group 2 - All other targets.

5. When a specific group containing several targets is processed, the target with the highest priority is considered first. If any targets have the same priority value, the target closest to the fire unit is selected. (It is in this screening process that a greater number of priority categories may be found desirable.)

6. Once a target has been selected, the method of attack table is scanned for the choice of munitions to use. (The fire unit's weapon system is already known.) The first choice encountered that is within the range limits, and for which the fire unit has at least enough munitions for the first volley, is the method of attack selected. If no choice is acceptable the target is deleted from the group being considered, and the reduced target group is scanned again. This procedure is repeated until the

target group is exhausted or a target is selected and assigned. When a group is exhausted, the next specified target group is identified and processed in the same fashion until all the groups have been considered or until a target is finally selected and assigned.

(c) Moving Target Time Duration. Moving targets are checked each time a fire unit scans the target list for a new fire mission. If the estimated distance the target has moved since the last time it was detected is greater than 3000 meters, the target is dropped from the list and is not engaged. This parameter is representative of a target duration factor to establish a time window for moving targets [refer to Legal Mix IV study (Reference 3) and the TACFIRE Cost Effectiveness Study (Reference 2) for discussions of the time duration established for targets].

(d) Fire Mission Volley Scheduling. The portion of the routine handling the assignment of successive volleys proceeds as for DSL-ordered fire. During any fire mission, no fire unit will be interrupted and assigned to a higher priority target. Thus, fire units are unavailable for the duration of their current mission assignment.

APPENDIX A

TACTICAL FIRE DIRECTION SYSTEM INPUT REQUIREMENTS

1. INTRODUCTION. The actual Tactical Fire Direction System (TACFIRE) is a tactical automated data processing system with computer centers located at field artillery battalion and division artillery levels. In the DIVWAG System the TACFIRE Model simulates the tactical fires of a division force. The purpose of this appendix is to provide instructions for entering data into the TACFIRE Model constant data base. Data unique to the model are addressed in this appendix. The order in which this appendix appears in this manual is not indicative of the priority that should be assigned in the acquisition of data. The data for this model may be entered in any order with respect to all other models.

a. Data Required. The data required for the DIVWAG TACFIRE Model are those associated with targets, priorities of targets, weapon ranges, and time to fire on the target. For the Blue force most of the data needed can be obtained from technical manuals and pamphlets where standard conventional tube and missile artillery is concerned. For Red force the data will usually be derived from intelligence channels and threat studies. Most of the information required is standard actual TACFIRE data.

b. Appendix Format. The first paragraph of this appendix explains the purpose of the appendix and its contents. The second paragraph describes the data base used by the TACFIRE Model.

2. TACFIRE DATA BASE. TACFIRE, as characteristic of other models, has both a unique and a common data base. Chapter 3, TOELD, provides the instructions to develop data entries in the common data base. This appendix provides the detailed instructions for data preparation and entry into the unique data base. Additional unique data are also supplied by the Area Fire assessment load routine, AFMLD. Figure IV-9-A-1, TACFIRE Model Data Base, illustrates flow of data between the model and its data bases. At the center right of the figure is the unique data base file 25 for the TACFIRE Model. The load program, TACLD, reads in the data from the three card formats into data file 25. At the upper left is the unique data base supplied to the TACFIRE Model by the Area Fire assessment load program, AFMLD. This data base is loaded onto data files 25 and 29 and contains weapon/munitions characteristics data pertinent to the weapon delivery characteristics used in TACFIRE, as well as munitions effects data used in the assessment routine, AREAFR. At the bottom of the figure is the common data base available on the unit status file, (USF), data file 1. The TACFIRE Model uses the dynamic USF data to maintain current files on the fire units in the system. Data file 12 contains the target arrays fed from the Intelligence and Control Model after appropriate delays. The target list, along with the fire unit status records, is also maintained on data file 25 for use in TACFIRE. The TACFIRE Model develops its own fire events, posts the times to fire in the event time table, and maintains the

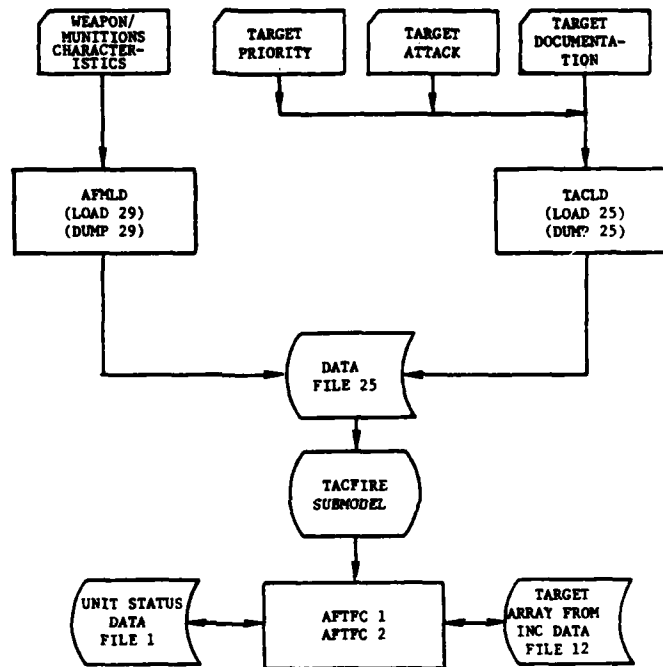


Figure IV-9-A-1. TACFIRE Model Data Base

current target location, munitions type, and number of rounds on the fire unit's status record in data file 25. The USF provides for both friendly fire unit status and unit strength and quantities of equipment in hostile target units. The target priorities and method of attack are constant TACFIRE data bases and are not changed during the course of an engagement or during the total game cycle, but unit status on data file 1 and the target list and division fire unit's status list on data file 25 are dynamically changed as the game progresses.

3. DATA REQUIRED. The TACFIRE unique data base consists of three sets of tables that are loaded prior to game play: (1) weapon/munitions parameters table, (2) target priority tables, and (3) method of attack tables. In summary, the first table, weapon/munitions, lists the valid combinations of artillery weapons and ammunition for target defeat. It is loaded by the Area Fire assessment load program, AFMLD. Target priorities, as determined from a consideration of target intelligence information estimates of target type, activity, size, and range from the enemy target unit to the nearest friendly forces, are developed in the Target Priority Tables. The Method of Attack Tables list the weapon/munition combinations that may be employed to defeat the targets, the order of preference or choice among the various combinations available to the force, and the number of volleys desired or required to achieve a prescribed level of damage criterion against each target.

a. TACFIRE Constant Data Matrix. To assist in developing a detailed overview of the type of data required for the data bases and to develop systematic techniques to enter this data base into the TACFIRE Model through the load program, a constant data matrix is illustrated in Figure IV-9-A-2, Matrix of TACFIRE Data Requirements. It is suggested that these or similar matrices be prepared with the TACFIRE data prior to transcription to punch card format compatible with the computer TACLD program. Figure IV-9-A-2 is a composite of the three phases required to develop the data base. These three phases consist of: (1) identify the target with respect to type, activity, and size; (2) assign priorities to this target based on its type, activity, size, and proximity to friendly forces; and (3) specify the desired weapons/munitions combinations and the level of fire desired against the target. This three-phase process is repeated, using a separate data matrix form for each distinct target identified, until all possible targets have been considered. Details of this process are described fully in subsequent paragraphs. The three tables representing the phases of this process are the Target Type and Activity Table, Figure IV-9-A-2A; the Target Priority Table, Figure IV-9-A-2B; and the Method of Attack Table, Figure IV-9-A-2C. Note that the identification of the target size is actually accomplished in Figures IV-9-A-2B and IV-9-A-2C, and not in Figure IV-9-A-2A.

(1) Target Type and Activity. Figure IV-9-A-2A, Target Type and Activity, lists the various type hostile units and the activities that are recognized within the model. Only those target combinations identified in preparation of the data base will be used as valid combinations within the model. Combinations other than those listed in the type and activity lists

A

B

C

C

C

in the figure are not subject to TACFIRE scheduled artillery fire. Also, not all combinations or matches are necessarily required since some are obviously exceptions that do not occur in reality. Air defense missiles or guns do not "engineer." The term "engineer" is used in the model to indicate the usual functions, such as road building, repairs, bunkering, or obstacles. Thus, an engineer unit, listed as type 10 hostile unit in Figure IV-9-A-2A, would be expected to "engineer." This table of target types is used to identify the target type and target activity to which the subsequent priority and method of attack tables apply. An example is shown in Figure IV-9-A-3A where an armor type unit (type index 2) in a nonmoving or stay activity (activity index 1) is being considered. This would be consistent with an armor unit in an assembly area prepared to move out for any one of a number of assignments.

(2) Priority Table (Figure IV-9-A-2B). Once the target type and activity have been selected it remains to specify the target size before developing the target's priority values.

(a) Notice that all size targets of the specified type and activity are considered on a single data matrix form. Also note that the model recognizes only four size categories: platoon, company, battalion, and brigade/regiment. The size variations may not be organizationally consistent with the activity and type index (e.g., if the target type were enemy tube artillery, and the size estimated as a company, the target would in reality be an artillery battery); but for purposes of filling out the tables, combinations typified by this example should be treated as if the correct nomenclature were specified. Each specified size is considered individually in developing the target priority values used in this table. Priority is based on the type, activity, and size of the hostile target and its position relative to the nearest friendly troops. It should be emphasized that for proper model performance it is critical that target priorities be consistently assigned to the various target combinations considered. A method of developing an overview of the priority assignment scheme is discussed in paragraph 3b below.

(b) The completion of the target priority table requires five entries for each target size considered. Two parameters establish the target range intervals for use in assigning priorities, and the other three are the actual priority values assigned to the target when it is in each of the three range intervals. Since a target of a specified type and size may be located at various distances from friendly forces, and since this proximity is a key consideration in assigning the target priorities, it is necessary to specify range intervals before assigning target priority values. Also, this means that a target may have up to three different priority values dependent upon its location in the dynamic game play. To represent the potential threat of a target versus range to the nearest maneuver unit the range is divided into three range intervals. Figure IV-9-A-4 illustrates a typical situation involved in developing the range and priority values.

A

Hostile Unit		Activity	
Code	Type	Code	Posture
(A)	(B)	(C)	(D)
1	Infantry	①	Stay
②	Armor	2	Move
3	Mech	3	Fire
4	Reinf Task Force	4	Attack
5	Tube Arty	5	Defend
6	Missile Arty	6	Engineer
7	AD Guns	7	Withdraw
8	AD Missiles		
9	Airbase		
10	Engineer		
11	Command Post		

B

Target Size		Priority	Range	Priority	Range	Priority
Code (F)	Orgn (F)	(G)	Meters (H)	(I)	Meters (J)	(K)
1	Platoon	1	5,000	2	15,000	3
2	Company	1	7,500	1	10,000	2
3	Battalion	1	10,000	2	15,000	2
4	Bde/Regt	1	12,500	1	17,500	2

C

Order of Choice			19	20
	1 (L)	2 (H)	(AD)	(AE)
Weapon Type				
Weapon Item Code				
Ammunition Type				
Ammunition Item Code				
Weapon/Munition Index				
Number Volleys				
On Platoon Size Unit				
On Company Size Unit				
On Battalion Size Unit				
On Bde/Regt Size Unit				



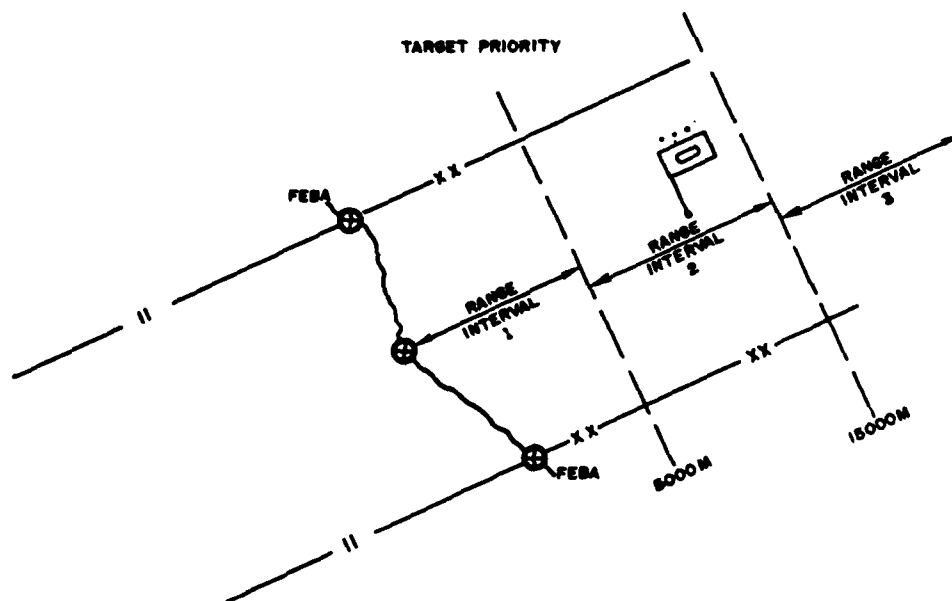


Figure IV-9-A-4. Range Intervals for Target Priorities

(c) Suppose that the first range interval extends to 5,000 meters and that the second interval is chosen from 5,000 to 15,000 meters. The armor platoon, if in range interval 2, is not considered as serious a threat as it would be if it were in range interval 1; therefore, the platoon might be awarded a priority of 1 in the first range interval and 2 in the second interval. At distances greater than 15,000 meters the platoon is a considerably lesser threat and may be assigned a priority value of 3. Thus, in this example of the armor platoon in an assembly area, typical range intervals of 0 to 5,000 meters, 5,000 meters to 15,000 meters, and greater than 15,000 meters are described by the entries, 5,000 and 15,000 meters, and the corresponding priority of such a target in each range interval is given by 1, 2, and 3. If it is desired not to assign a priority to a target in a range interval, the letter N is entered indicating that the target is not to be considered for a fire mission and, therefore, will not be fired upon by the model. Similar range intervals and priorities are listed for target sizes greater than the armor platoon (company, battalion, and brigade/regiment size armor units in their assembly area) to complete the target priority table. This table, when completed for the example, as illustrated in Figure IV-9-A-3B, will contain the priorities assigned to each hostile armor unit in an assembly area or similar type stationary mode as seen from the friendly force commander's viewpoint.

(3) Method of Attack. The method of attack table, Figure IV-9-A-2C, identifies the weapon and munition combinations available in the friendly force, develops an order or preference in which they should be employed against the target, and defines the level of attack to be delivered against the specified target type to achieve target defeat. It is through use of the data entered in this table that the TACFIRE Model selects the appropriate available fire units and assigns them fire missions against hostile targets. Each target combination identified in phase 1 must have a method of attack table if it is to be fired upon within the model.

(a) Weapon/Munitions Choice. The first step in developing a method of attack table for a target is to determine all possible artillery weapon and munitions combinations that would be potential candidates to engage that target. Thus, in the example of the armor unit, assume that there are only two possible weapon types in the force that would be used against armor, the 8-inch howitzer and the 155mm howitzer. Furthermore, assume that the only type of round available or suitable for use against armor would be the dual purpose ammunition rounds for the 8-inch howitzer and the 155mm howitzer. Thus, two possible weapon/munitions combinations could be employed against armor units. The next step in filling out the method of attack table is to decide the order of preference among the weapon/munitions combinations identified in the first step. The selection of a specific weapon and munitions for target engagement will often depend largely on the munitions and delivery system available; however, if several different engagement options are available, it is necessary to specify preferences in selecting the combinations. (In the example, if both a 155mm howitzer battalion and an 8-inch howitzer battalion were available to attack the armor unit, which weapon system is preferred?) The preferences can be determined by optimizing the expected results of the engagement in terms of the number of battalion volleys required, the coverage expected, and the time required to attack the target; therefore, it is suggested that these forms be prepared by personnel familiar with field artillery and munition target relationship studies performed for USACDC and USAMC. When the preferences of the weapon/munition combinations have been established, the combinations are entered into Figure IV-9-A-2C as follows:

1. Under column (L) the weapon type and ammunition type of the preferred or first choice are listed. Under the column (M) the second preferred combinations, under column (N) the third choice, and so on until all combinations defined in the first step have been entered. A maximum of 20 combinations is allowed; in most cases this will be more than adequate. It should be noted that any combination not listed as a choice will never be allowed to fire on this particular target; therefore, any viable weapon/munition combination should be listed unless specific military doctrine dictates otherwise. Note also that the arrangement in the order of preference applies to all size targets in the attack table.

2. Referring to the example of the 8-inch howitzer and 155mm howitzer, both with dual purpose ammunition, the 8-inch has been selected as the first choice and entered in column (L), while the 155mm howitzer was indicated as the second choice. Thus, regardless of the size of the armor unit, the 8-inch howitzer with the dual purpose round will be the first choice combination; and the model, in selecting a fire unit for a fire mission against any size armor units in stay type activities, will try first to find an available 8-inch howitzer battalion. Failing to do so it will proceed to the second choice, the 155mm howitzer, and search for available 155mm howitzer battalions. If more choices existed the model would continue in this fashion until either a fire unit was selected or until the combinations were exhausted. In the latter instance the target would be backlogged until an appropriate fire unit became available.

(b) Number of Fire Unit Volleys. To complete the method of attack table it is required that the level of attack be specified in terms of the number of volleys desired against each size target identified.

1. To properly determine the number of volleys to be fired on specific target sizes, a predetermined attack criterion or level of damage or casualties must be established. A suggested attack criterion is defined as the fixed level of damage required to disrupt the unit integrity of the target. Thirty percent fractional damage to the primary element will be required to achieve this threshold for all materiel targets and 25 percent for personnel. Tables are available to assist the analysts in preparing these forms. The USACDC study, Munitions-Target Relationships Study (USACDC ACN 13277), August 1969, provides adequate data for predicting the number of volleys to achieve a specified attack criterion. The series of Legal Mix studies conducted by the USACDC Field Artillery Agency also contain similar data.

2. In developing the level of attack tables, it should be remembered that the fire unit size being gamed must be considered before specifying the number of volleys. The fire unit sizes are defined in pregame TOE loads. Any size fire unit is allowed in the TACFIRE Model, and the only restriction is that the total number of fire units placed in the TACFIRE mode does not exceed 36 per division. The crucial fact in filling out the attack tables is that the number of volleys specified in the level of attack tables is the number of volleys that will be fired by the fire unit if selected for the mission. Furthermore, the TACFIRE Model logic does not explicitly consider the size of the fire unit in the selection process. Thus, for example, if a 155mm howitzer battery and a 155mm howitzer battalion have been defined as fire units in the game they will be considered as equally viable candidates for fire missions. (For proper model performance the use of different size fire units, both having the same weapon munition combinations available, is not recommended. Different size fire units for different weapon types is, however, completely acceptable.) In the example of Figure IV-9-A-2B, if the fire unit is a 155mm howitzer battery, then a total of 2 volleys or 12 rounds would be fired on the platoon size targets. If, however, the fire unit

were a 155mm howitzer battalion, the 2 volleys of 18 rounds, or a total of 36 rounds, would be fired.

3. Continuing with the example in which an armored platoon is in stay posture, a battalion of 8-inch howitzers might fire one volley to achieve a 30 percent fractional damage on this target. The same may be true with the 155mm howitzer. In Figure IV-9-A-2C the one volley for the 8-inch howitzer is entered on the line immediately below number of volleys and opposite platoon in column (L); the one-volley indication for the 155mm howitzer would be entered on that same line in column (M).

4. The number of volleys to achieve a 30 percent fractional damage on a company size target could be two volleys for the 8-inch howitzer and two for the 155mm howitzer. For battalion size targets three volleys using the 8-inch and three volleys for the 155mm howitzer could be required. Since engagement of large area targets by nonnuclear munitions is not effective unless large amounts of ammunition are fired, a radius of target (R_T) for personnel should be no greater than 600 meters, and for materiel targets should be no greater than 400 meters. Thus, when deciding on the number of volleys that could be fired against large area targets (R_T greater than 600 meters) such as brigade and regimental size targets, the same number of volleys fired on battalion size targets should be used. Following this rule, the 8-inch howitzer might fire three volleys and the 155mm howitzer would fire three volleys on brigade size targets. These figures would be entered in the appropriate columns and lines as explained for the platoon and the two howitzers. The resultant data entries, using the figures cited in the example, might appear as shown in Figure IV-9-A-5, TACFIRE Method of Attack Table Completed.

b. Target Priorities. The target priorities used in the TACFIRE Model are related to those discussed in FM 6-20 and explained in this chapter. For emphasis this information is repeated in this subparagraph. These priorities are based on the relative military worth of the candidate target to the friendly forces. In order of priority this military worth is measured in capability of: (1) preventing execution of the plan of action, (2) immediate serious interference with plan of action accomplishment, (3) ultimate serious interference with plan of action, and (4) limited interference with the execution of the plan of action. Each hostile target is assigned to these categories based on the target's type, size, activity, and proximity to the nearest friendly forces. This priority scheme forms the basis for developing the target priorities used in the TACFIRE Model and can be implemented after considering the model's reaction to target priorities.

(1) The assignment of priorities to targets should be developed with firm understanding of how the model will use these priority values. Whereas the four priority categories as defined in FM 6-20 are primarily based on a consideration of the target in relation to the friendly forces as a whole, the model uses these priorities in a slightly different, although not incompatible, manner. The model priorities are essentially attack priorities, which are used to determine in what order targets are to be attacked when there

A

Hostile Unit		Activity	
Code	Type	Code	Posture
(A)	(B)	(C)	(D)
1	Infantry	①	Stay
②	Armor	2	Move
3	Mech	3	Fire
4	Reinf Task Force	4	Attack
5	Tube Arty	5	Defend
6	Missile Arty	6	Engineer
7	AD Guns	7	Withdraw
8	AD Missiles		
9	Airbase		
10	Engineer		
11	Command Post		

B

Target Size		Priority	Range	Priority	Range	Priority
Code (E)	Orgn (F)	(G)	Meters (H)	(I)	Meters (J)	(K)
1	Platoon	1	5,000	2	15,000	3
2	Company	1	7,500	1	10,000	2
3	Battalion	1	10,000	2	15,000	2
4	Bde/Regt	1	12,500	1	17,500	2

C

Order of Choice			19 (AD)	20 (AE)
	1 (L)	2 (M)		
Weapon Type	8 in How	155 How		
Weapon Item Code				
Ammunition Type	Dual Pur	Dual Pur		
Ammunition Item Code	34	34		
Weapon/Munition Index				
Number Vollers				
On Platoon Size Unit	1	2		
On Company Size Unit	2	2		
On Battalion Size Unit	3	3		
On Bde/Regt Size Unit	3	3		

C

are not enough fire units available to attack all the targets. When establishing target priorities, a model rule to be kept in mind is that the model will select the target closest to the firing unit for those targets having the same priority. The remaining targets can be engaged by other fire units as they become available or by this fire unit when it becomes available again after completing the fire mission just assigned. For example, assume that an attacking tank company, an attacking mechanized company, and a self-propelled artillery unit that is firing have been detected and placed on target list due to the unavailability of fire units. Furthermore, assume that all these targets have been categorized as priority 1 targets. As soon as a fire unit becomes available it will engage the closest of the three targets, if within range. If it is desired always to attack the mechanized company first, regardless of the range, then it is necessary to distinguish among the three using the priority values. This can be accomplished within the existing model structure since it can accommodate up to nine distinct priority categories (1 through 9).

(2) These priorities might be developed from the four priorities previously defined in the following manner. After completing the target priority table based on the four-priority scheme, arrange all the target combinations considered by the priority assigned; that is, group all priority 1 targets together, all priority 2 together, etc. Then within each priority category consider the various targets listed with regard to the attack priority and form subpriorities. For example, within all the priority 1 targets there may be a group of targets that is always to be engaged first, and a group that can be engaged second. Proceeding in this manner the subpriorities might finally be arrived at for all the groups where the priority 1 targets were grouped into five attack subpriorities for the model's use, priority 2 targets into two attack subpriority groups, priority 3 targets into one subpriority, and priority 4 targets into one attack subpriority. Thus, a priority 1 target would have an attack subpriority of 1, 2, 3, 4, or 5; priority 2, a subpriority of 1 or 2; and priority 3 and 4 targets, a subpriority of 1.

(3) The actual priorities to enter in the priority tables would be developed as follows. For priority 1 targets the value of the subpriorities would be entered (1, 2, 3, 4, 5); for priority 2 targets, the values 6 or 7 would be entered to denote priority 2 targets with attack subpriority 1, (6), and priority 2 targets with attack subpriority 2, (7); for priority 3 and 4, values of 8 or 9, respectively, would be entered. In effect, a model scale of nine attack subpriorities would be developed, which would contain the initial four-category priority scheme. Thus, continuing with the previous three target examples, the attacking mechanized company might be assigned a model attack priority of 1, while the armor company attacking would receive a model attack priority of 3, but both targets would still be priority category 1 targets as defined above.

(4) It is emphasized that while the use of only four categories of target priorities can be directly implemented into the model without development of the subpriority groups, the decision to do so should be made only after a thoughtful overview of the target combinations and priority assignments has indicated that the use of these priorities within the model is consistent with military reality.

c. Integrity of Priorities. A completed TACFIRE data matrix for an armor unit in the stay posture with the data used in the example should appear as illustrated in Figure IV-9-A-5. A similar TACFIRE matrix must be prepared for each target type and activity combination. Once this set of TACFIRE data matrices has been completed, the question remains as to what degree the user is confident that the priorities assigned in these separate forms are consistent with each other. It is suggested that an overview of the assigned priorities be made and summarized for discussion among those preparing the data and the managers of the war game. A form for this purpose has been prepared and is illustrated in Figure IV-9-A-6, TACFIRE Summary of Target Priorities for Platoon/Company, and in Figure IV-9-A-7, TACFIRE Summary of Target Priorities for Battalion/Brigade. In Figure IV-9-A-6, left side, is illustrated a form for the platoon. At the top is listed each of the activities and the priorities associated with each of the three range intervals. Along the left side of the form is a list of the different types of enemy targets. All data entries in Figures IV-9-A-6 and IV-9-A-7 are taken directly from the Priority Tables developed for each target type and activity combination.

(1) To illustrate how data are entered into these forms, the priority data from Figure IV-9-A-5 have been entered. Using this summary, the internal consistency of all assigned priorities can be examined. Inconsistencies discovered may then be corrected and changes made on the appropriate forms. This summary form is to be completed prior to transferring the data base to card formats.

(2) After the data have been loaded by the TACLD routine, a second summary form is generated by the load program. This form or listing is also intended for use as an overview of the priorities assigned to the targets. In this summarized list, all targets assigned a priority of 1 are grouped with complete type, activity, size, and range interval identifications. Similarly, all priority 2 targets are grouped into a second category, all priority 3 targets into a third category, and all priority 4 targets into a fourth category. A schematic of the program listing is shown in Figure IV-9-A-8. The summarized list of the targets by order of priority is intended to be used as a supplement to the summary forms of Figures IV-9-A-6 and IV-9-A-7, as well as to provide the departure point for assigning attack subpriorities as discussed in subparagraph b above. The procedure would be to use the TACLD summary forms and the data preparation summary forms in Figures IV-9-A-6 and IV-9-A-7 to assign a new set of attack subpriorities to the target combinations and reload the data with this set of priorities.

PLATOON										COMPANY									
TYPE ACTIVITY										TYPE ACTIVITY									
	STAY	MOVE	FIRE	ENGR	ATK	DEFEND	WD			STAY	MOVE	FIRE	ENGR	ATK	DEFEND	WD			
Infantry	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉	R ₁₀
Armor	1	2	3							1	2								
Mechanized																			
Reinforced																			
Task Force																			
Tube																			
Artillery																			
Missile																			
Artillery																			
ADA Guns																			
ADA Missiles																			
Airbase																			
Engineer																			
Command Post																			

Figure IV-9-A-6. TACFIRE Summary of Target Priorities for Platoon/Company

BATTALION										BRIGADE/REGIMENT									
TYPE ACTIVITY							TYPE ACTIVITY												
STAY	MOVE	FIRE	ENGR	ATK	DEFEND	WD	STAY	MOVE	FIRE	ENGR	ATK	DEFEND	WD						
R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3	R 1 2 3						
Infantry							Infantry												
Armor							Armor												
Mechanized							Mechanized												
Reinforced Task Force							Reinforced Task Force												
Tube Artillery							Tube Artillery												
Missile Artillery							Missile Artillery												
ADA Guns							ADA Guns												
ADA Missiles							ADA Missiles												
Airbase							Airbase												
Engineer							Engineer												
Command Post							Command Post												

Figure IV-9-A-7. TACFIRE Summary of Target Priorities for Battalion/Brigade

Assigned Priority	Target Type	Target Activity	Target Size	Range Interval (Meters)
1	Armor	Stay	Platoon	0-5,000
1	Armor	Stay	Company	0-7,500
1	Armor	Stay	Company	7,500-10,000
1	Armor	Stay	Battalion	0-10,000
1	Armor	Stay	Brigade/Regiment	0-12,500
1	Armor	Stay	Brigade/Regiment	12,500-17,500
.				
.				
2	Armor	Stay	Platoon	5,000-15,000
2	Armor	Stay	Company	10,000-
2	Armor	Stay	Battalion	10,000-15,000
2	Armor	Stay	Battalion	15,000-
2	Armor	Stay	Brigade/Regiment	17,500-
3	Armor	Stay	Platoon	15,000-
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4				
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.				

Figure IV-9-A-8. TACLD Target Priority Summary List

BATTALION										BRIGADE/REGIMENT									
TYPE ACTIVITY							TYPE ACTIVITY												
STAY	MOVE	FIRE	ENGR	ATK	DEFEND	WD	STAY	MOVE	FIRE	ENGR	ATK	DEFEND	WD						
R	R	R	R	R	R	R	R	R	R	R	R	R	R						
1	2	3	1	2	3	1	1	2	3	1	2	3	1						
2	3	1	2	3	1	2	2	3	1	2	3	1	2						
3	1	2	3	1	2	3	3	1	2	3	1	2	3						
Infantry							Infantry												
Armor							Armor												
Mechanized							Mechanized												
Reinforced							Reinforced												
Task							Task												
Force							Force												
Tube							Tube												
Artillery							Artillery												
Missile							Missile												
Artillery							Artillery												
ADA Guns							ADA Guns												
ADA Missiles							ADA Missiles												
Airbase							Airbase												
Engineer							Engineer												
Command Post							Command Post												

Figure IV-9-A-7. TACFIRE Summary of Target Priorities for Battalion/Brigade

Assigned Priority	Target Type	Target Activity	Target Size	Range Interval (Meters)
1	Armor	Stay	Platoon	0-5,000
1	Armor	Stay	Company	0-7,500
1	Armor	Stay	Company	7,500-10,000
1	Armor	Stay	Battalion	0-10,000
1	Armor	Stay	Brigade/Regiment	0-12,500
1	Armor	Stay	Brigade/Regiment	12,500-17,500
.				
.				
.				
2	Armor	Stay	Platoon	5,000-15,000
2	Armor	Stay	Company	10,000-
2	Armor	Stay	Battalion	10,000-15,000
2	Armor	Stay	Battalion	15,000-
2	Armor	Stay	Brigade/Regiment	17,500-
3	Armor	Stay	Platoon	15,000-
.				
.				
.				
4				
.				
.				
.				

Figure IV-9-A-8. TACLD Target Priority Summary List

4. PREPARATION OF THE TACFIRE DATA BASE FOR CARD INPUT. When the data entries in the TACFIRE constant data matrix have been completed, the next step is to index this information and transfer it to punched card formats. Three punched card formats are required by the TACLD program: the TACFIRE Target Range/Priority Card Format, Figure IV-9-A-9; the TACFIRE Method of Attack Card Format, Figure IV-9-A-10; and the TACFIRE Target with Priority and Method of Attack Card Format, Figure IV-9-A-11. Briefly, TACFIRE target range/priority contains the target priority and range interval information, the TACFIRE method of attack contains the data in the method of attack table, and the target with priority and method of attack associates the target type and activity with the corresponding priority table and the method of attack table. This procedure is described in greater detail in subsequent paragraphs; however, before discussing the actual transfer of data to the card formats, it is necessary to describe the various indexes required to identify the target type, activity, and size, and also to identify the weapon and munitions types found in the method of attack tables.

a. Weapon and Munitions Indexing. The weapon/munitions combination index is one of the more significant indexes developed for TACFIRE. It is also used in the Area Fire Model in assessing losses for both personnel and equipment. This index relates the specific weapon, as identified by its equipment item code, with a type of ammunition that can be fired by that weapon, the ammunition also being identified by its item code. The weapon/munitions index is then used to identify the performance parameters of the combination; such as maximum and minimum ranges, munitions CEP, elapsed time to fire first round, and sustained rates of fire. The lethal area of the munitions against equipment and personnel is also identified using the weapon/munitions index.

(1) Weapon Identification. Each weapon and munitions combination issued to units whose fire missions are scheduled by the TACFIRE Model or by DSL orders must be given a weapon/munitions combination index (see Figure IV-9-A-12). Tube type artillery, missile artillery, rockets, and selected types of mortars all qualify for this category. The list of weapons should be obtained from the TOE primary items list or from the list prepared by DIVWAG System management personnel. A careful check should be made to ensure that all candidate weapons are included in this list.

(a) Listing Weapons. In Figure IV-9-A-12 the weapon/munitions combination index has been preprinted in the far left column headed (A). These indexes are arbitrarily assigned numbers and may be applied to any combination weapon and ammunition. The item code of the weapon is listed in column (B). These item code numbers may be listed in any order. The maximum number of combinations allowed by the model is 36. It is suggested that the item code numbers for weapons be entered in numerical order as they are listed in the TOE. In this manner future checks for weapon list completeness or other purposes will provide items in numerical order.

[illegible]

Figure IV-9-A-11. TACFIRE Target with Priority and Method of Attack Card Format

Weapon and Ammunition Combination Index (A)	Weapon		Ammunition	
	Item Code (B)	Nomenclature (C)	Item Code (D)	Nomenclature (E)
1	24	8-in howitzer	34	Dual purpose rnd, 8-in
2				
3				
4	25	155mm howitzer, SP	35	Dual purpose rnd, 155mm
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				

Figure IV-9-A-12. Weapon/Munition Combinations

(b) Nomenclature. It may prove time saving and introduce better understanding of the game if the nomenclature of each weapon item code number and ammunition item code number were entered in columns (C) and (E), respectively. This information is useful to the players as well as to those preparing the data base.

(2) Ammunition. There are usually several different types of ammunition that may be used with a single weapon system. The ammunition may be listed in any sequence as long as it is associated with its correct weapon. It is suggested that item code numbers for ammunition be listed in ascending order. If a type of ammunition is removed from the file the entire list of weapon/munition combinations must be renumbered so that there is no gap in the assigned numbers; that is, if the ammunition for weapon/munitions index 18 were deleted, then all weapon/munition indexes after number 18 must be renumbered beginning with 18.

(3) Utilization of the Weapon/Munition Combination Index. In the TACFIRE Model the weapon/munitions combination index is used in preparing the method of attack table as illustrated in Figure IV-9-A-5. This is the index that is later transferred to card format 1 (ID 2502) as illustrated in Figure IV-9-A-13. After the method of attack table in each of the TACFIRE data matrices has been completed, the weapon item code, the munition item code, and the weapon/munition combination index are entered into each method of attack combination listed in the table. The indexes of the 8-inch howitzer and the 155mm howitzer used in the example are listed in Figure IV-9-A-13, TACFIRE Data Matrix Completed.

b. Target Priority and Method of Attack Table Indexes. The target priority table index and the method of attack table index are established in the data preparation phase to identify the priority table and method of attack table for each combination of target type and activity. Since it is anticipated that in certain instances the same priority and/or method of attack tables will be applicable to a specific target type in several activities or to several target types in the same activity, these table indexes are included to allow the method of attack and target priority tables to be entered only once and then referenced by their indexes if required again. For example, the target priority and method of attack used against enemy tube artillery units and missile artillery units may be the same. Rather than prepare two data matrixes, both of these target types can be identified in a single data matrix in the target activity and type table and the corresponding priority and attack table assigned arbitrary indexes. When the data are entered into the formats the tables are entered only once and are referenced to the correct target type and activity in the TACFIRE target and priority with method of attack format cards (see Figure IV-9-A-9). The assignment of these indexes is accomplished as follows:

Step 1: Complete a TACFIRE data matrix for each enemy target type and activity combination of interest to the TACFIRE Model.

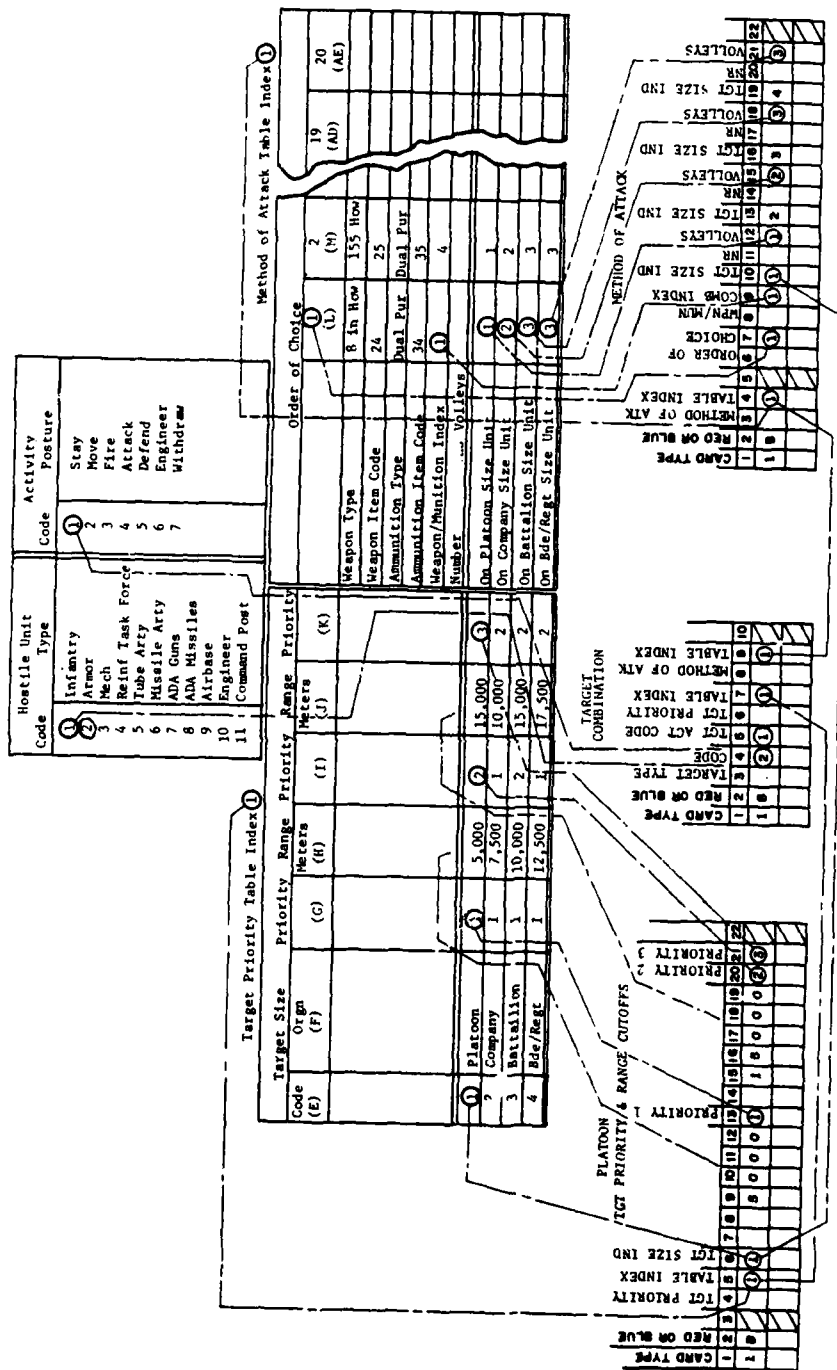


Figure IV-9-A-13. TACFIRE Data Matrix and Card Formats

Step 2: Assign a target priority table index number to each of the data matrices as follows: assign the first priority table the index number 1; if the second priority table is different from the first, assign it the index number 2; otherwise, assign it the index number 1. If the third priority table is different from the first two tables, assign it index number 3; otherwise, assign it the same index number as the priority table it is identical with. Proceeding in this way each distinct priority table will be assigned a distinct index.

Step 3: Assign method of attack table indexes following the same procedure used in Step 2. In the example of the armor unit in a stay activity, Figure IV-9-A-13, the indexes assigned to each of these tables were both 1 as this was the first TACFIRE data matrix completed.

c. Card Format Data Entries. After the proper indexes have been established for the data matrixes, this information is entered into the card formats for keypunching. The transfer of data entries is illustrated in Figure IV-9-A-13 where the card formats with the example data entries are shown at the bottom of the figure.

(1) The TACFIRE target range priority card format (Figure IV-9-A-9) contains the preprinted card type index 1, column 1; the force code for Red or Blue (R or B), column 2; the target priority table index, columns 4 and 5; the target size index, column 6; the range interval cutoff values, columns 7-12 and columns 14-19; and the three target priority values assigned in these range intervals in columns 13, 20, and 21, respectively. This sequence (columns 6-21) is repeated for each size target as it is listed in the target priority table. One of these cards (ID 2501) contains all data listed in a single target priority table.

(2) The TACFIRE method of attack card format (Figure IV-9-A-10) is filled out as illustrated in the lower right corner of Figure IV-9-A-13. The card type is preprinted as 1 in column 1, and the force type R or B is entered in column 2. The index to the method of attack table is entered in columns 3 and 4. Each weapon/munitions combination listed is then entered by identifying the order of choice in columns 6 and 7, the weapon/munitions combination index in columns 8 and 9, and the size of target and number of volleys in that order in columns 10-21. The sequence of columns 6-21 is repeated until all choices have been entered from the method of attack table.

(3) After the preceding card formats have been completed, the TACFIRE target priority with method of attack card formats (Figure IV-9-A-11) are used to identify the target type and activity combinations with the correct priority and method of attack table. This format is illustrated in the lower center portion of Figure IV-9-A-13. For every combination of enemy target type and target activity the corresponding target priority table index and method of attack table index are entered.

5. SUMMARY OF DATA BASE PREPARATION. The process whereby the TACFIRE data base is developed, transferred to card formats, and loaded onto files can be briefly summarized in the following steps:

Step 1. Identify all possible combinations of target types and activities that are desired for the game from the list of types and activities available in the model.

Step 2. Prepare a TACFIRE data base matrix form for each of the combinations defined in step 1.

Step 3. Fill out the priority and method of attack tables appropriate to each data base form.

Step 4. Fill out the priority summary form and check priorities assigned for consistency. Make changes as necessary.

Step 5. Index the weapon/munition combinations, the method of attack table, and assign indexes to the priority table and method of attack table.

Step 6. Transfer the data in the data base matrixes onto the card formats for keypunching.

Step 7. Load data.

Step 8. Use the priority summary listing of load program and the summary form prepared in step 4 to evaluate priority assignments. If refinement is necessary repeat steps 4, 6, 7, and 8 until consistency is achieved.

6. TACFIRE CONSTANT DATA DECK STRUCTURE. This paragraph describes the data deck structure for constant data input used in the TACFIRE Model. The cards making up the deck and the order in which they must be read into the DIVWAG system are discussed.

a. TACFIRE Constant Data Input Cards. These cards are listed in Figure IV-9-A-14. In the figure the card type column contains the number punched in card column 1 for each of the card formats listed. The next column is labeled force designator and indicates Blue force data and Red force data. The title of each card format and the identifier number are given next. The load program for each card is listed at the far right. These are the card formats, produced in multiple copies of each in some instances, that are used to create and update the constant data files for TACFIRE.

Card Type	Force	Card Title	Card ID	Load Program Name
1	B	TACFIRE Range/Priority Definition	2501	LOAD25
1	B	TACFIRE Method of Attack	2502	LOAD25
1	B	TACFIRE Scheme Against Red Targets	2503	LOAD25
1	R	TACFIRE Range/Priority Definition	2501	LOAD25
1	R	TACFIRE Method of Attack	2502	LOAD25
1	R	TACFIRE Scheme Against Blue Targets	2503	LOAD25

Figure IV-9-A-14. TACFIRE Constant Data Input Cards

b. Creating Constant Data Files for TACFIRE. The TACFIRE constant data input file is created by reading in the data deck structured as illustrated in Figure IV-9-A-15. In this figure are a series of subdecks, each of which contains specific types of data. Range/priorities is the first set of data to be entered in the file. As shown in the figure the first set of subdecks is for Blue force and the next set is for Red force. This sequence must be adhered to in entering the data deck into TACFIRE constant data files. All the Blue force range/priority data to be entered into card ID 2501 are prepared; and when the cards are punched, they are arranged into the subdeck as shown. Immediately in front of this subdeck is placed the leader card having only the numbers 2501 punched into card columns 73-76. This is the only data that appears on the lead card. Immediately behind the last data card of range/priorities (type 1 and ID 2501) is the lead card of the next card format; similar arrangements are made for each of the succeeding subdecks as illustrated in Figure IV-9-A-15. After assembling data for Blue force is completed, data for the Red force are accumulated. The last card in the data deck for Red force in ID 2503, card type 1, is followed by an end of file card. The end of file card has four nines punched in card columns 73 through 76. To the load program this indicates that the last card for this file has been read and it is time to process and print the constant data input reports. In this manner the data deck is ready for entry into the computer after the control cards are inserted.

c. Updating TACFIRE Constant Data Files. Changes to the data read into the constant data files for TACFIRE can be readily accomplished through the use of the retained TACFIRE data deck. The updating may consist of correction of an error in one data element, the deletion of information, or the addition of new data. The following procedures govern these functions.

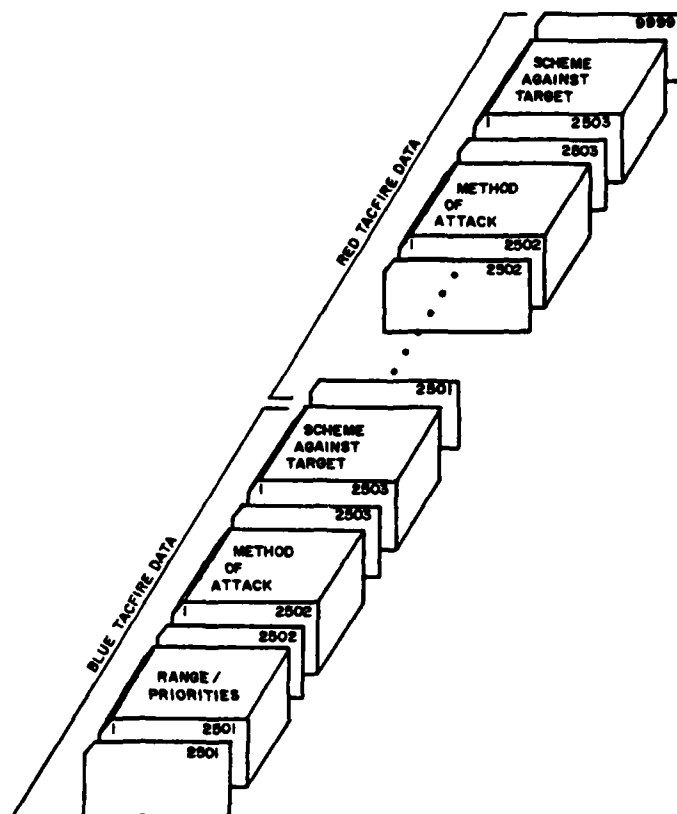


Figure IV-9-A-15. TACFIRE Data Deck Structure

(1) Correcting an Error. Correcting an error or changing a data element is the equivalent of updating TACFIRE constant data files. The card with the error or data to be changed is located and a new card is produced with the correct or changed data punched in. The old card is removed from the deck, and the new card is inserted in its location. The entire data deck for both Red and Blue forces is submitted for another run on the computer system. The recreation of the constant data files by reading in the data deck with the changed data on cards constitutes the correcting of an error or the changing of a data element.

(2) Deletion of Information. The deletion process may consist of deleting the entire file or deleting one data element or a record. For deleting the entire TACFIRE constant data file the process consists of using the control cards to erase all disk storage for the TACFIRE data. To delete a data element, select the card or cards that have the unwanted data in the files. These cards are removed from the data deck, and the purged deck is then submitted for reread to the computer system. The omission of those cards will cause that data to be eliminated from the data base in the process of recreating the files.

(3) Addition of Data. Data may be added at any time prior to the start of the game. The procedure is to prepare the cards having the data to be added to the files. When these cards are punched they are to be integrated into the data deck simply by placing each of the cards in the appropriate subdeck as illustrated in Figure IV-9-A-15. The completed and expanded data deck is submitted to the computer system for rerun. Each time that the data are entered in the TACFIRE constant data input file there are printouts generated showing the new file information.

APPENDIX B

TACFIRE MODEL PROGRAM DESCRIPTIONS

1. INTRODUCTION. The TACFIRE Model is composed of three routines. AFTFC1 and AFTFC2 perform the calculations required; OVER9 serves as an entry point to the TACFIRE overlay. The macro flow of the TACFIRE Model is shown in Figures IV-9-1, IV-9-2, and IV-9-4.

2. ROUTINE OVER9:

a. Purpose. OVER9 calls AFTFC1 or AFTFC2, depending upon whether a target is to be added to the target list or a candidate fire unit is to be assigned a target.

b. Input Variables:

(1) Standard Common Block Areas. UMAIN and UCOOP.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
ETTAB(2)	ONE	Event table entry (code, time).

c. Output Variables. None.

d. Logical Flow (Figure IV-9-B-1). If the event code equals 11, AFTFC1 is called; otherwise, AFTFC2 is called.

3. ROUTINE AFTFC1:

a. Purpose. When possible, AFTFC1 assigns a fire unit to fire on the target requested by the Intelligence and Control Model through a target array. Using the method of attack table to determine how to attack the target, it checks if there are any available units capable of firing the mission using the most preferred method of attack. If so, the mission is assigned. If not, the method of attack table is checked until all possible methods have been tried. If fire support is not available, the target is assigned a priority based on its size, type, activity, and distance from the front-line maneuver units. The target is added to the target list. If the target list is full, the target with the lowest priority is deleted from the list and the new target is inserted.

b. Input Variables:

1. Standard Common Block Areas. UMAIN.

2. Other Variables:

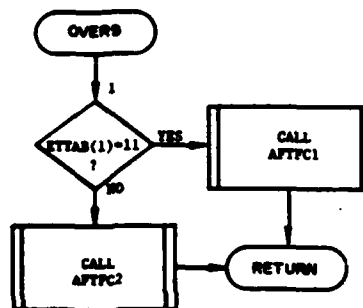


Figure IV-9-B-1. Routine OVER9

IV-9-B-2

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<u>Name</u>	<u>Source</u>	<u>Contents</u>
FILE12	TWO	Target array.
LUID		FILE12 (1). IUID of detecting unit.
KUID		FILE12 (3) IUID of unit sending request.
RPTNO		FILE12 (5). Sensing report number.
MUID		FILE12 (6). IUID of the target.
ESTX		FILE12 (7). Estimated X coordinate of the target.
ESTY		FILE12 (8). Estimated Y coordinate of the target.
ESTSZ		FILE12 (9). Estimated target size.
ESTYPE		FILE12 (10). Estimated target type.
ESTACT		FILE12 (11). Estimated target activity.
MOVRAT		FILE12 (12). Estimated movement rate.
ESTDIR		FILE12 (13). Estimated direction of movement.
TIMDET		FILE12 (23). Time of last detection.
ISENST		FILE12 (30). Sensor type.
DIVZON (2,3)	DF25	Division zone table.
PTYTAB (4,5)	DF25	Target priority table.
FUNIT	ZONDAT	IUIDs of front-line maneuver units.
UTDTAB (1000)	TWO	Unit type designators of all units.
FUSRCD (1080)	DF25	Fire unit status array (36 fire units).
IUDFU (36)		FUSRCD (1). IUIDs of fire units.
IFUMC (36)		FUSRCD (37). Fire unit mission code.
FUPOC (36)		FUSRCD (73). Fire unit pending order code.
IWEAP (36)		FUSRCD (109). Weapon equipment item code.

<u>Name</u>	<u>Source</u>	<u>Contents</u>
MAXRG (36)	DF25 (cont'd)	FUSRCD (145). Maximum range (meters).
MINRG (36)		FUSRCD (181). Minimum range (meters).
WMIDX (4,36)		FUSRCD (217). Weapon-munition indexes.
ASRPC (4,36)		FUSRCD (361). Available supply rate (ASR) priority cutoff.
ASRA (4,36)		FUSRCD (505). ASR authorized.
ASREX (4,36)		FUSRCD (649). ASR expended.
FUMAC (36)		FUSRCD (793). Fire unit mission assignment code.
NBNVA (36)		FUSRCD (829). Number of volleys assigned.
NBNVF (36)		FUSRCD (865). Number of volleys fired.
NORA (36)		FUSRCD (901). Number of rounds per volley.
WMIDXA (36)		FUSRCD (937). Weapon-munition index of assigned mission.
TFMCMP (36)		FUSRCD (973). Time to complete mission.
XTARG (36)		FUSRCD (1009). Target X coordinate.
YTARG (36)		FUSRCD (1045). Target Y coordinate.
TGTLST (816)	DF25	Target list array (48 targets).
LMUID (48)		TGTLST (1). IUIDs of targets.
LRPTNO (48)		TGTLST (49). Latest sensing report number.
LESTX (48)		TGTLST (97). Estimated X coordinate.
LESTY (48)		TGTLST (145). Estimated Y coordinate.
LMOVRT (48)		TGTLST (193). Estimated move rate.
LESTDR (48)		TGTLST (241). Estimated move direction.
LTMDTL (48)		TGTLST (289). Time of last detection.
LTGTIX (48)		TGTLST (337). Target size-type-activity index.

<u>Name</u>	<u>Source</u>	<u>Contents</u>
LLUID (48)	DF25 (continued)	TGTLST (385). Requesting unit IUID.
LIUREQ (48)		TGTLST (433). Request code.
LIDDS (48)		TGTLST (481). IUID of direct support unit.
LMANID (48)		TGTLST (529). IUID of nearest friendly maneuver unit.
LTGTPC (48)		TGTLST (577). Target priority code.
LNFMAS (48)		TGTLST (625). Number of fire missions assigned.
LOFATK (48)		TGTLST (673). Level of attack assigned.
LTGTE (48)		TGTLST (721). Time target entered AFTFC1.
LESTSZ (48)		TGTLST (769). Estimated size.
MATKA (100)	DF25	Method of attack table. (20 methods in order of preference).
MWIND (20)		MATKA (1). Weapon-munition combination index.
NVPLT (20)		MATKA (21). Number of volleys on platoon target.
NVCO (20)		MATKA (41). Number of volleys on company target.
NVBN (20)		MATKA (61). Number of volleys on battalion target.
NVBDE (20)		MATKA (81). Number of volleys on brigade target.
WMNPA (396)	DF25	Weapon-munition data array (36 weapon-munition combinations).
IPWEOH (36)		WMNPA (1). Weapon equipment item code.
IPMEOH (36)		WMNPA (37). Munition equipment item code.
ITRONE (36)		WMNPA (73). Time to fire first round (seconds).

<u>Name</u>	<u>Source</u>	<u>Contents</u>
ITRN (36)	DF25 (cont'd)	WMNPA (109). Time to fire rounds 1-N (seconds).
ITRS (36)		WMNPA (145). Time to fire subsequent rounds (seconds).
IRNCO (36)		WMNPA (181). Nth round cutoff.
MPPT (36)		WMNPA (217). Minimum personnel per weapon.
MUNWT (36)		WMNPA (253). Munition weight (pounds per round).
MWRMAX (36)		WMNPA (289). Maximum range (meters).
MWRMIN (36)		WMNPA (325). Minimum range (meters).
MWIR (36)		WMNPA (361). Impact radius (meters).

c. Output Variables:

- (1) Standard Common Block Variables. UMAIN.
- (2) Other Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
TGTLST (816)	DF25	Target list array.
FUSRCD (1080)	DF25	Fire unit status array.

d. Logical Flow (Figure IV-9-B-2):

- (1) Block 1. In order to decide which division is responsible for the zone containing the target, DIVZON is filled from data file 25 and searched.
- (2) Block 2. IDIVZ is equal to the code number of the division responsible for the target's zone.
- (3) Block 3. If the target is not in a zone of responsibility, a message is printed. Control returns to the calling routine.
- (4) Block 4. Read the fire unit status array and the target list array for the division from data file 25.
- (5) Block 5. If the report is not from a ground combat unit, a check is made to determine if this is a redundant report (i.e., the target unit is already on the target list or being fired on). If this is a redundant

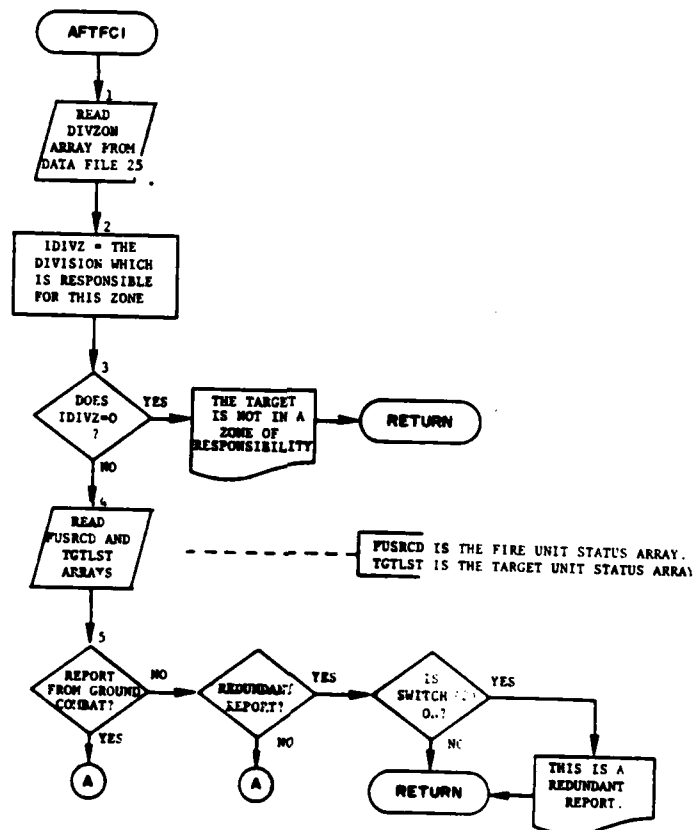


Figure IV-9-B-2. Routine AFTFC1 (Continued on Next Page)

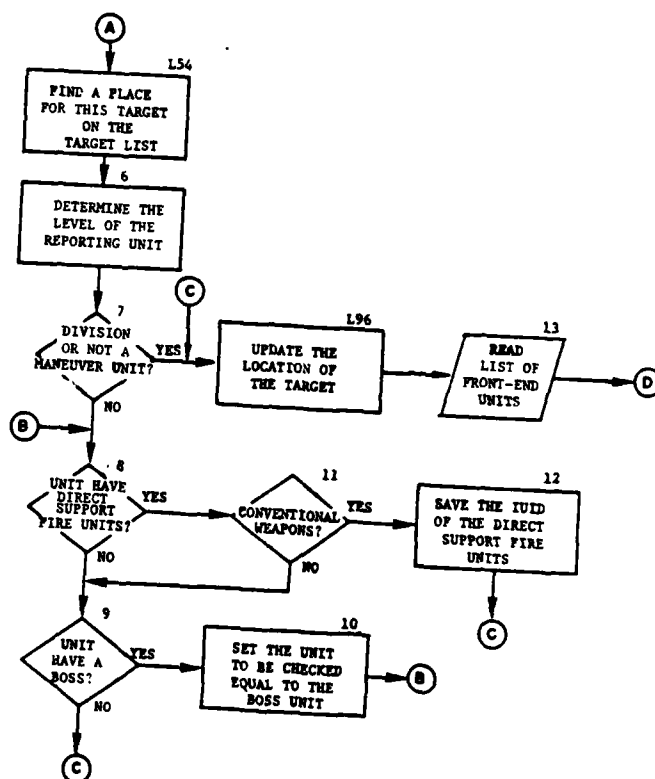


Figure IV-9-B-2. Routine AFTFC1 (Continued)

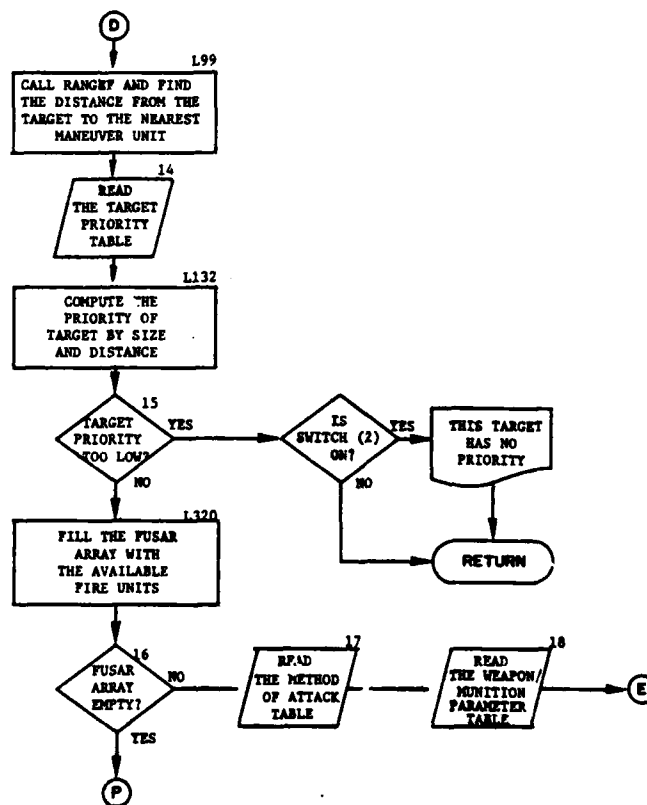


Figure IV-9-B-2. Routine APTFC1 (Continued)

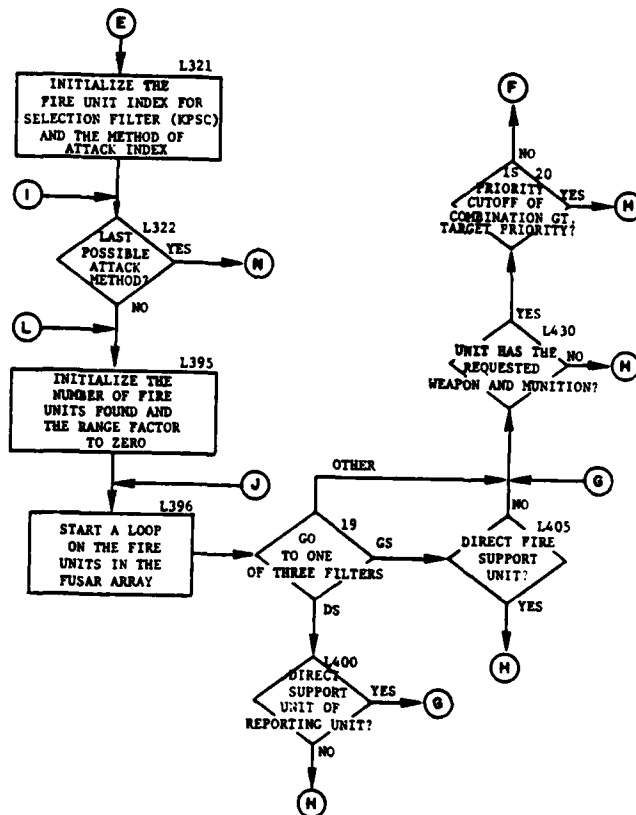


Figure IV-9-B-2. Routine AFTFC1 (Continued)

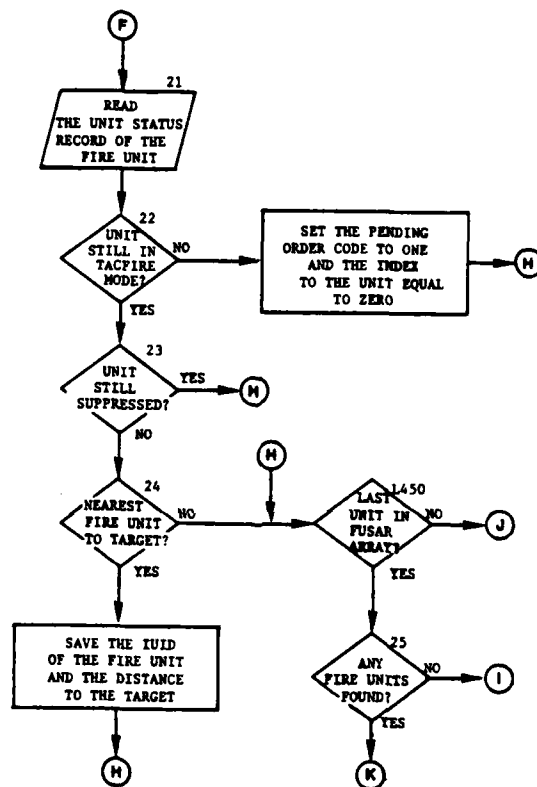


Figure IV-9-B-2. Routine AFTFC1 (Continued)

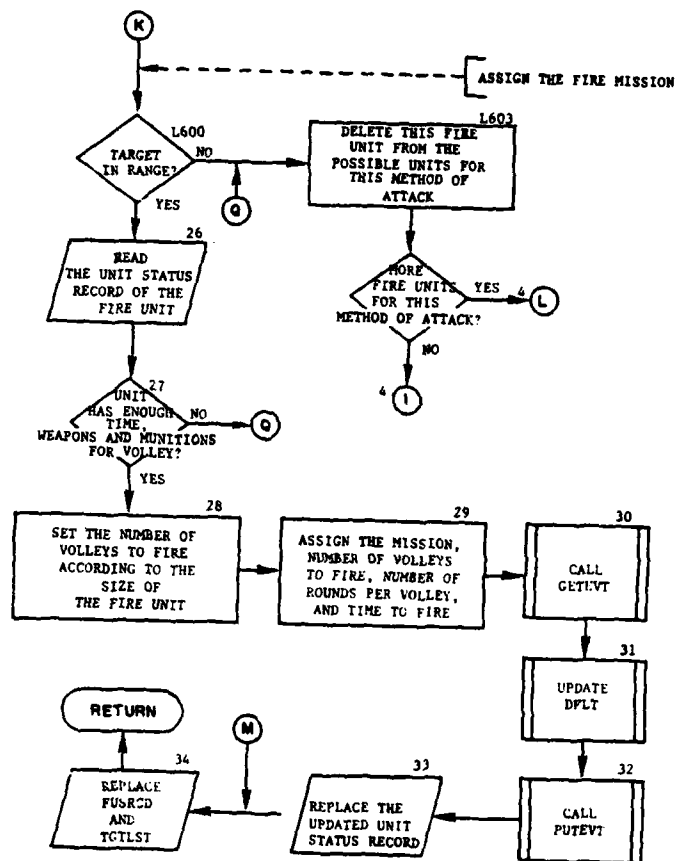


Figure IV-9-B-2. Routine AFTFC1 (Continued)

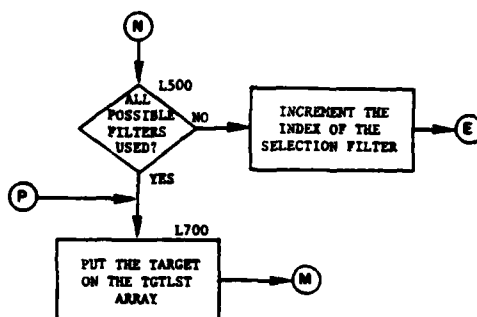


Figure IV-9-B-2. Routine AFTFC1 (Concluded)

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report and switch (2) = 1, a message is printed and control returns to the calling routine.

(6) Block L54. The target list is searched for a place to put this target. If there are no positions open, the target with the lowest priority on the list is found and the index to the target list entry where it appears is saved. If it is necessary to add this target to the list, the index will be used.

(7) Block 6. Determine from the UTDTAB table if the reporting unit is a division, brigade, or battalion.

(8) Block 7. If the reporting unit is a division or is not a maneuver unit, go to block 196.

(9) Block 8. Bring in the unit status record of the reporting or superior unit and determine if it has any direct support units. If it does have direct support units, go to block 11.

(10) Block 9. If the reporting unit has no direct support and has no superior unit, go to block 196.

(11) Block 10. Replace unit by its superior unit and go to block 8.

(12) Block 11. If the direct support unit does not have conventional weapons, go to block 9.

(13) Block 12. Save maximum of two IUIDs of direct support units which have conventional weapons.

(14) Block 196. Update the location of the target. If the target is moving, calculate its present location according to the estimated location, move rate and direction, and time since detection.

(15) Block 13. Bring in the FUNIT array, the list of front-line maneuver units, from data file 16.

(16) Block 199. Search the FUNIT array for the unit closest to the target. Calculate the distance from this unit to the target for use in computing the priority of the target.

(17) Block 14. Bring in the target priority table from data file 25.

(18) Block 1132. Find the priority of the target according to the distance to the nearest front-line maneuver unit and the estimated size of the target.

(19) Block 15. If the priority is greater than or equal to 100, the priority is too small and a message is printed if switch (2) = 1.

(20) Block L320. Add all available fire units to the FUSAR table. They must be in the TACFIRE mode and must not have a target assigned to them. For units that qualify, the range from the fire unit to the target is calculated; and, if it is less than the fire unit's minimum range or greater than its maximum range, it cannot be added to FUSAR.

(21) Block 16. If the FUSAR array contains no fire units capable of firing the mission, go to block L700.

(22) Block 17. Read the method of attack table from data file 25 to determine the possible methods of attacking this target.

(23) Block 18. Read the weapon-ammunition parameter table from data file 25 for checking types of weapons and ammunitions.

(24) Block L321. Initialize the pointer to the fire unit selection filter to be used: 1, if there are direct support units available; 3, if not. Set the method of attack index to zero.

(25) Block L322. Increment the index for the method of attack table by one; and, if this index is greater than 20, go to block L500.

(26) Block L395. Initialize the number of fire units found for this method of attack to zero and the range factor to zero.

(27) Block L396. Start a loop to search the FUSAR array containing available fire units for one to fire on this target.

(28) Block 19. Determine the fire unit selection filter according to the filter index.

(29) Block L400. If this is not one of the direct support units for this target go to block L450; otherwise, go to block L430.

(30) Block L405. If this is a direct support unit go to block L450; otherwise, go to block L430.

(31) Block L430. If the candidate fire unit is not authorized the selected weapon-munition combination go to block L450.

(32) Block 20. If the target's priority is not high enough for this fire unit, go to block L450.

(33) Block 21. Read the unit status record of this candidate fire unit from data file 1 for further checking.

(34) Block 22. If the unit is no longer in the TACFIRE mode, set the pending order code to 1, remove the unit from the list of possible fire units, and go to block L450.

(35) Block 23. If the candidate fire unit is suppressed by some previous action, go to block L450.

(36) Block 24. Compute distance from this fire unit to the target. If it is the closest unit, save the IUID.

(37) Block L450. If this was not the last fire unit on the list, obtain the next unit and go to block 396 to process the next unit.

(38) Block 25. If no units were found to fire on this target, go to block L322 to process next method of attack.

(39) Block L600. Compute the range from the fire unit to the target. If the range is within limits go to block 26; otherwise, go to block L603.

(40) Block L603. Delete fire unit under consideration from the list of possibilities for this method of attack. If there are no more fire units for this method of attack, go to block L322; otherwise, go to block L395 and select the next unit.

(41) Block 26. Read the unit status record of this unit if it is not in UMAIN.

(42) Block 27. Check the number of required type weapons and munition that the unit has on hand. If the unit has an insufficient amount, go to block L603.

(43) Block 28. Compute the number of volleys required by this unit to complete the mission as a function of the fire unit size.

(44) Block 29. Assign the fire mission to the unit and update the fire unit status array with the number of volleys to fire, number of rounds to fire per volley, time to fire first round, and location of target. If the unit is not capable of firing at least one round per volley, the mission is not assigned and control goes to block L603.

(45) Block 30. Call GET EVT to get the time to end the unit's current stay event.

(46) Block 31. Update DELT for the time unit has stayed before the fire event is scheduled.

(47) Block 32. Call PUT EVT to schedule the completion of the stay event for this unit. The unit will be processed by AFTFC2 after being updated by STAY.

(48) Block 33. Replace the updated unit status record.

(49) Block 34. Replace the updated FUSRCD and TGTLS arrays on data file 25 and return to the calling routine.

(50) Block L500. If all possible fire unit selection filters have not been used, increment the index for filters and go to block L321.

(51) Block L700. Put the target on the target list. If necessary, the target with the lowest priority may be removed to allow the new target to be added. Control goes to block 34.

4. ROUTINE AFTFC2:

a. Purpose. AFTFC2 assigns a target to a fire unit if possible. The fire unit is added to the list of fire units for use by its parent division, unless the list is full and no fire units may be deleted from the list. Fire units are deleted if they are no longer in TACFIRE mode. A list of available targets is created and searched to determine if any targets are suitable for this fire unit; and, if so, the highest priority target is assigned to the fire unit. If no targets are found, the fire unit is given a stay event. If the fire unit already has a fire mission a check is made to determine if the mission was completed. The unit continues with the mission if it is not complete; otherwise, an attempt is made to assign a new mission.

b. Input Variables:

(1) Standard Common Block Areas. UMAIN.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
FUSRCD (1080)	DF25	Fire unit status array.
TGTLST (816)	DF25	Target list array.
MATKA (100)	DF25	Method of attack table.
WMNPA (396)	DF25	Weapon-munition parameter table.

(Note: Detailed breakout of the arrays FUSRCD, TGTLST, MATKA, and WMNPA is contained in the description of routine AFTFC1).

c. Output Variables:

(1) Standard Common Block Variables. UMAIN.

(2) Other Variables. FUSRCD and TGTLST as listed for input variables.

d. Logical Flow (Figure IV-9-B-3):

(1) Block 1. Determine the parent division for the fire unit and bring in the appropriate TGTLST, FUSRCD, WMNPA tables from data file 25.

(2) Block L4. Search the FUSRCD array for the fire unit IUID. If the fire unit is on the FUSRCD array, go to block L100.

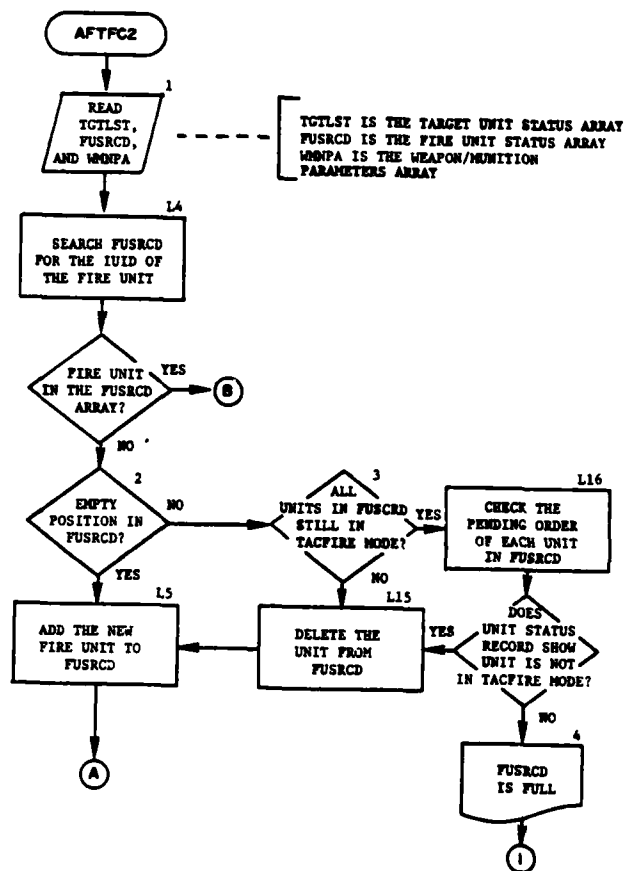


Figure IV-9-B-3. Routine AFTFC2 (Continued on Next Page)

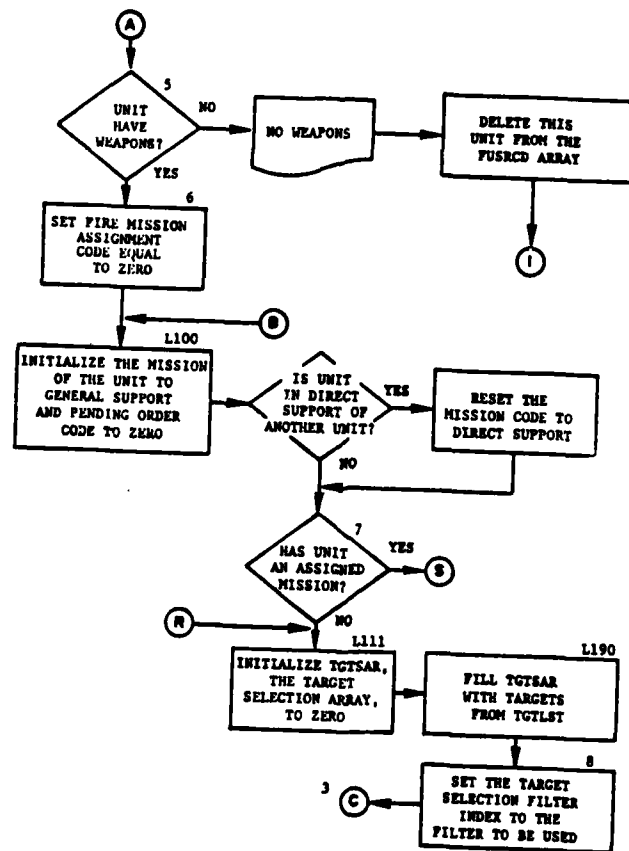


Figure IV-9-B-3. Routine AFTFC2 (Continued)

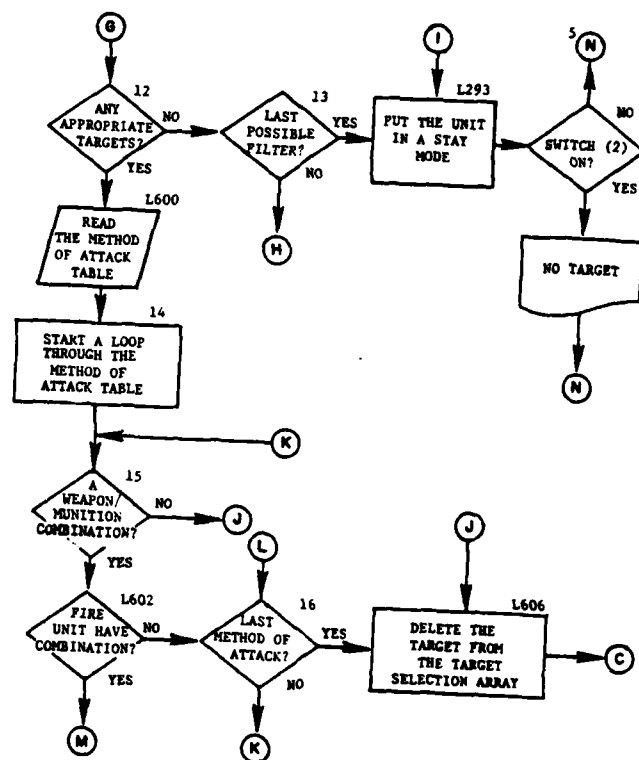


Figure IV-9-B-3. Routine AFTFC2 (Continued)

IV-9-B-21

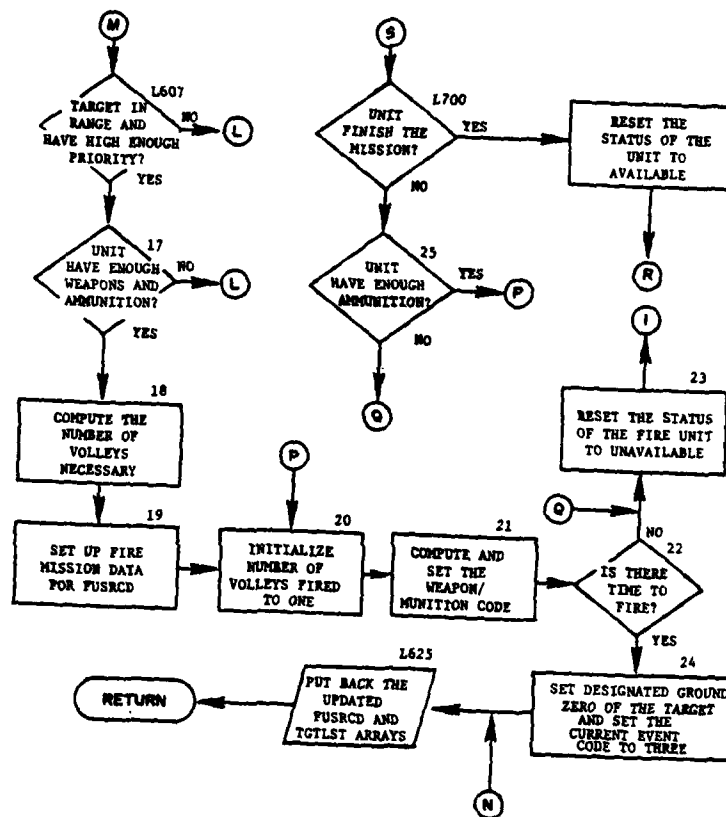


Figure IV-9-B-3. Routine AFTFC2 (Concluded)

IV-9-B-22

(3) Block 2. If, while searching for the fire unit in the FUSRCD array, an empty position was found, go to block L5.

(4) Block 3. If a unit was found in FUSRCD that was no longer in the TACFIRE mode, go to block L15.

(5) Block L16. Check the order code of each unit on the unit status record; if one is found which does not have a TACFIRE order code, go to block L15.

(6) Block 4. Print a message stating the FUSRCD array is full. Go to block L293.

(7) Block L15. Delete the unit from the FUSRCD array.

(8) Block L5. Place the fire unit on the FUSRCD array in the position found with its minimum and maximum ranges and weapon and munition types.

(9) Block 5. If the unit has no weapons, print an appropriate message and delete the unit from the FUSRCD array. Go to block L293.

(10) Block 6. Set the fire mission assignment code to zero.

(11) Block L100. Set the unit's mission as general support and the pending order code to zero; however, if the unit is in a direct support mission, reset the mission code.

(12) Block 7. If the unit has been assigned a fire mission, go to block L700.

(13) Block L111. Zero the target selection array (TGTSAR).

(14) Block L190. Fill TGTSAR with targets from the target list which have been there no more than 2 hours, are estimated to have moved no more than 3000 meters, and are within range of the fire unit.

(15) Block 8. Initialize the target selection index according to the mission of the fire unit, direct or general support.

(16) Block L195. Initialize the least distance from a front-line unit to 1000000, the highest priority to 100, and the IUID of the selected target to zero.

(17) Block L280. Begin a loop through the targets listed on the target selection array.

(18) Block 9. If the unit reporting this target or requesting fire on the target has any direct support units, determine the IUIDs of these supporting units.

(19) Block 10. Select one of three possible target selection filters according to the filter index set in block 8.

(20) Block L210. If this fire unit is one of the direct support units to the unit reporting this target, go to block L230.

(21) Block 11. If this was the last target on the target list, go to block 12; if not, return to block 9 to process the next target.

(22) Block L220. If this target's reporting unit has any direct support units, omit this target and go to block 11.

(23) Block L230. Compare the priority of this target to the highest priority previously found. If this priority is higher than the maximum priority so far, go to block L202. If this target's priority is lower than the maximum so far, go to block 11. (A high priority target has a low priority index number, and a low priority target has a high priority index number.)

(24) Block L201. If the priority is equal to the maximum, compare the distances to the nearest front-line unit; if this target is not closer than the previously selected target, go to block 11.

(25) Block L202. Reset maximum priority, distance to the nearest unit, and the IUID of the target selected to the corresponding values of this target. Go to block 11.

(26) Block 12. If a suitable target was found for this fire unit, go to block L600.

(27) Block 13. If this was not the last possible selection filter, increment the filter index and go to block L280.

(28) Block L293. Since there is no target for this fire unit at the present time, the unit is placed on a STAY event. If switch (2) = 1, a message is printed. Go to block L625.

(29) Block L600. Read the method of attack table from data file 25 to find a most suitable method for this fire unit to attack its selected target.

(30) Block 14. Begin a loop through the method of attack table entries.

(31) Block 15. If there is not another weapon-munition combination, go to block L606.

(32) Block L602. If one of the fire unit's weapon-munition combinations matches this one, go to block L607.

(33) Block 16. If this was not the last method of attack, go to block 15.

(34) Block L606. Delete this target from the target selection array since the fire unit cannot attack it. Go to block L195.

(35) Block L607. If the target is not within range of the fire unit or the target's priority is not high enough for this fire unit, go to block 16.

(36) Block 17. Does the unit have sufficient weapons and munitions to fire this mission? If not, go to block 16.

(37) Block 18. As a function of the size of the fire unit, compute the number of volleys required to complete this mission.

(38) Block 19. Set the IUID of the target, number of volleys to fire, the weapon-munition index to use, and the location of the target in FUSRCD array.

(39) Block 20. Set the number of volleys fired equal to 1.

(40) Block 21. Set the weapon-munition code for the unit status record of this unit and store it in UMAIN.

(41) Block 22. Compute the time necessary to fire the required number of rounds. If there is sufficient time, go to block 24.

(42) Block 23. Reset the fire unit to indicate that it is not available for a mission and go to block L293.

(43) Block 24. Set the designated ground zero coordinates to those of the target and the event code to 3.

(44) Block L625. Replace the updated FUSRCD and TGTLS arrays on data file 25.

(45) Block L700. If the fire unit completed the fire mission, reset the unit's status to available and go to block L111.

(46) Block 25. If the unit exhausted its ammunition go to block 23. If not, go to block 20.

APPENDIX C

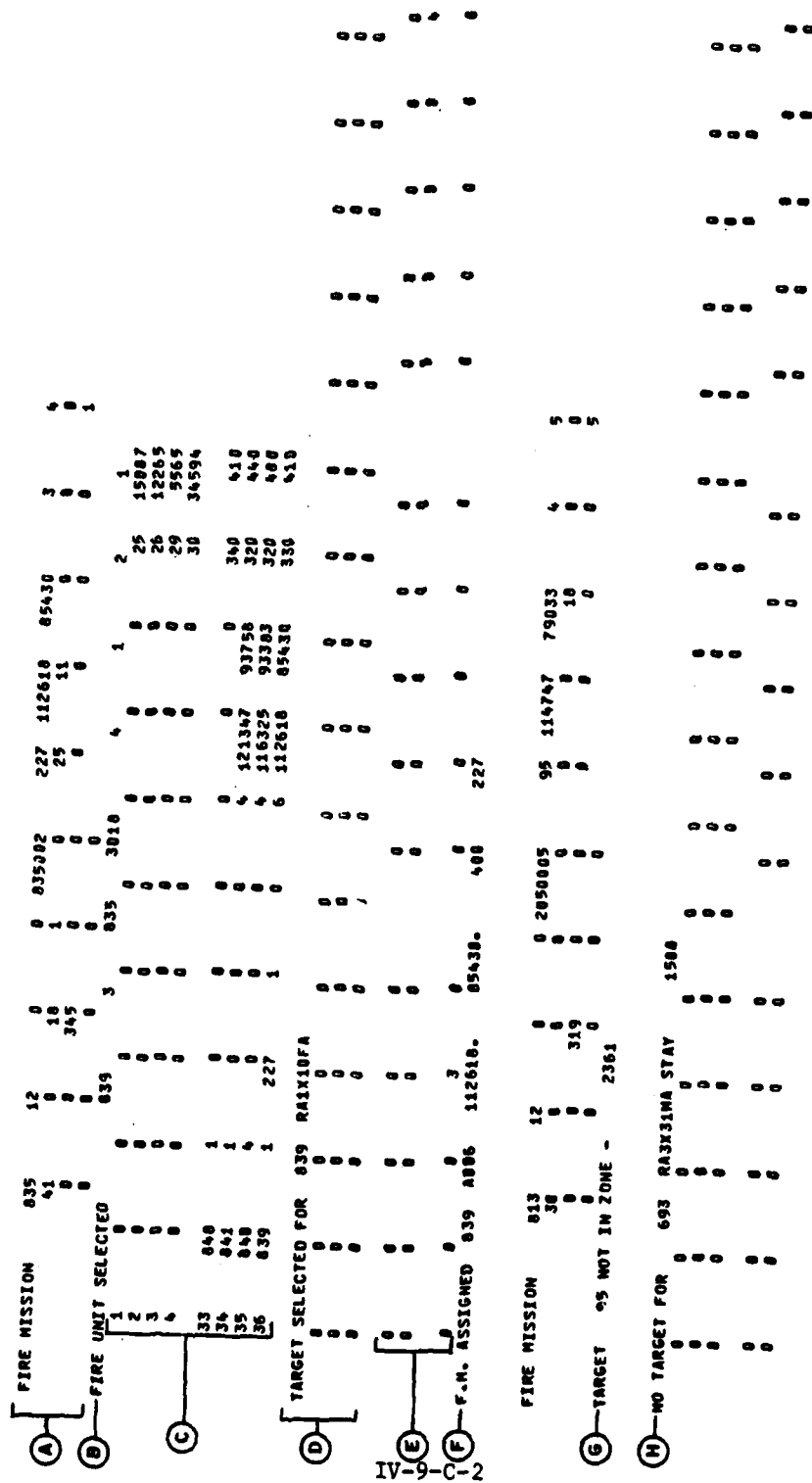
TACFIRE MODEL OUTPUT DESCRIPTIONS

1. INTRODUCTION. This appendix contains samples and detailed descriptions of printed output from routines within the TACFIRE Model of the Period Processor.

2. TACFIRE MISSION SCHEDULING. The TACFIRE Model schedules fire missions against targets of opportunity. This represents a wide range of targets including counterbattery fires, supporting fires requested by the Ground Combat Model, and sensor detected targets.

a. Printed Output. Figure IV-9-C-1 shows the format of TACFIRE Model print statements. All output is keyed to print switch 2. In the figure an alphabetical character (descriptor) designates an appropriate line, group of lines, or column that is explained as follows.

<u>Output Descriptor</u>	<u>Explanation</u>
A	FIRE MISSION: This entry lists the 35-word record of the fire mission sent to AFTFC1. This record contains the same entries as the Intelligence and Control Model's mission FILE12 record.
B	FIRE UNIT SELECTED: This message is printed when a fire unit has been selected and assigned a fire mission. The printed data following this message is as follows: <ul style="list-style-type: none">. IUID of fire unit selected. request code. IUID of the maneuver unit closest to the target. range to target from closest maneuver unit. priority assigned to target. selection filter index. method of attack choice index. number of volleys in fire mission.
C	The fire unit's status record is printed following the FIRE UNIT SELECTED and FIRE UNIT UNAVAILABLE messages. Each row contains the following information on the fire unit contained therein: <ul style="list-style-type: none">. status record index (1-36). IUID of the fire unit. fire unit mission code



Output
Descriptor

Explanation

- . target IUID of fire mission if currently assigned
 - . number of volleys assigned in fire mission
 - . number of volleys fired in the present fire mission
 - . weapon munitions combination index used in fire mission
 - . target's X coordinate
 - . target's Y coordinate
 - . index of fire unit in selection array
 - . range to target of fire mission unit.
- D TARGET SELECTED FOR (IUID) (UID): This message indicates that a fire unit has been selected for a fire mission or is scheduling a subsequent volley of a current fire mission. Following this message the 48-word array containing the IUIDs of all targets on the TACFIRE target list is printed.
- E This entry always follows the message in descriptor D above. The entry contains groups of five words per group. Each group lists a target considered in the target selection process, and contains the following information:
- . target's index in the target selection list (TGTLST)
 - . target's priority
 - . range of target to fire unit being considered
 - . target's X coordinate
 - . target's Y coordinate
- F F.M. ASSIGNED: This message is printed preceding each volley of every fire mission and includes information as follows:
- . IUID of the fire unit
 - . the weapon/munitions combination index fired
 - . X coordinate of the target
 - . Y coordinate of the target
 - . time to impact of rounds from time now
 - . IUID of the target.
- G TARGET () NOT IN ZONE (): This message occurs only when a mission request is sent to the TACFIRE Model and the target is not in a zone of one of the divisions. The message lists the target IUID and the time.

Output
Descriptors

Explanation

H

NO TARGET FOR (IUID) (UID) STAY (DELT): This message indicates that no target exists in the TACFIRE list which can be engaged by the fire unit (IUID,UID) at this time. The fire unit is assigned a 15-minute stay within the TACFIRE Model pending receipt of a new fire mission request. Following this message the 48-word array containing the IUIDs of all the targets on the TACFIRE target list is printed. The next set of data is grouped into 48 five-word groups. Each five word group contains the following:

- . target's index
- . target's priority
- . range to the target
- . X coordinate of the target
- . Y coordinate of the target

b. Other Print Statements. There are a variety of TACFIRE Model mission requests; therefore, each print statement was not included in Figure IV-9-C-1. Additional TACFIRE Model statements that appear as printed output are as follows:

MOVING TGT IUID = (IUID) DELETED FROM TGTLIST: This message is printed when a moving target has been dropped from the target list because it could not be engaged during the time allocated.

FIRE UNIT UNAVAILABLE: This message indicates a fire unit is not available for a fire mission. The information printed immediately following this message is the same as that following FIRE UNIT SELECTED (descriptor B).

(MUID) REDUNDANT: If a report is not from a ground combat unit, a check is made to see if it is a redundant report. A report is redundant if the target unit is already on the target list or is being fired upon. If it is a redundant report this message is printed giving the IUID of the target unit. AFTFC1 returns to the calling routine.

APPENDIX D

SOURCE LISTINGS FOR PERIOD PROCESSOR TACFIRE MODEL

(AVAILABLE UNDER SEPARATE COVER)

IV-9-D-1

APPENDIX E

REFERENCES

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2. TACFIRE Cost Effectiveness Study (U). USACDC Study, Main Report. June 1968. (ACN 13703). (SECRET).
3. Booz, Allen Applied Research, Inc. Optimum Mix of Artillery Units, 1975-1980 (Legal Mix IV). USACDC Study. 1 August 1970.
4. Booz, Allen Applied Research, Inc. DIVTAG II Tactical War Game System. Vol III, Technical Manual. (ACN 12392). November 1970.
5. US Department of the Army. FM 6-141-1, Nonnuclear Employment of Field Artillery Weapon Systems (U). 9 January 1967. (CONFIDENTIAL).
6. Institute of Nuclear Studies. Munitions-Target Relationships Study (U). USACDC Study. November 1969. (ACN 13277). (SECRET)
7. US Department of the Army. FM 6-20-1, Field Artillery Tactics. 1 July 1965.
8. Booz, Allen Applied Research, Inc., Optimum Mix of Artillery Units, 1975-1980 (Legal Mix III). USACDC Study. July 1967.

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CHAPTER 10

AIR GROUND ENGAGEMENT MODEL

1. MILITARY ACTIVITY REPRESENTED:

a. General:

(1) The Air Ground Engagement Model determines the losses of both aircraft and ground targets resulting from all air-to-ground or ground-to-air interactions, except those associated with aerial reconnaissance (Chapter 6 of this section) and airmobile assault operations (Chapter 15 of this section). The Air Ground Engagement Model represents Army rotary wing and fixed wing aircraft, with emphasis on the direct aerial fires (DAF)¹ role. High performance jet aircraft are represented in lesser detail, and only in the close air support (CAS)¹ role. The Air Ground Engagement Model is sensitive to changes in numbers, types, usage, and mixes of aircraft as well as to changes in the ground threat characteristics: weapons, deployment, and firing doctrine.

In addition the Air Ground Engagement Model will simulate the air delivery of scatterable mines. A request for a scatterable mine mission must be initiated through DSL. The model will simulate the allocation of resources, the flight to the proposed mine field location, including attrition to the mission unit from air-defense capable weapons, if appropriate, and the actual release of the mines on the target area. The model is sensitive to the type and number of aircraft participating in the mission as well as their velocity, altitude, mine strip width, and dispensing rate.

(2) The model treats the aerial attack of five target types under good or poor visibility conditions during daylight hours or night. Each of the 20 possible combinations of these factors is treated as a mission type, as enumerated in Figure IV-10-1. An additional factor, whether the aircraft does or does not penetrate enemy air space, makes a total of 40 mission types.

(3) For DAF missions, a first and a second choice aircraft/munition mix may be specified for employment. Losses or expenditures of DAF aircraft, fuel, personnel, and munitions are accounted for and are reflected in availability of resources for subsequent missions.

1. The term DAF in this chapter will be used to connote fires delivered by Army attack helicopters. The term CAS will connote supporting fires from high performance fixed wing aircraft, whether Red or Blue force.

Nonpenetration Mission Code	Penetration Mission Code	Description of Target
01	21	Tank unit, daylight, good visibility
02	22	Tank unit, daylight, poor visibility
03	23	Tank unit, night, good visibility
04	24	Tank unit, night, poor visibility
05	25	Mechanized infantry (motorized rifle) unit, daylight, good visibility
06	26	Mechanized infantry (motorized rifle) unit, daylight, bad visibility
07	27	Mechanized infantry (motorized rifle) unit, night, good visibility
08	28	Mechanized infantry (motorized rifle) unit, night, poor visibility
09	29	Artillery unit, daylight, good visibility
10	30	Artillery unit, daylight, poor visibility
11	31	Artillery unit, night, good visibility
12	32	Artillery unit, night, poor visibility
13	33	Infantry unit, daylight, good visibility
14	34	Infantry unit, daylight, poor visibility
15	35	Infantry unit, night, good visibility
16	36	Infantry unit, night, poor visibility
17	37	Airbase, daylight, good visibility
18	38	Airbase, daylight, poor visibility
19	39	Airbase, night, good visibility
20	40	Airbase, night, poor visibility

Figure VI-10-1. Air Ground Engagement Model Mission Types

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(4) CAS resources available are specified periodically during the game in terms of numbers of sorties of all-weather and good-weather aircraft to be made available in each 6-hour portion of a day. This sortie input is the sole constraint on CAS availability. High performance jet aircraft are assumed to be loaded with the most effective munition mix for each target type. Accordingly, no CAS aircraft/munition mix or other resources are specified or accounted for. CAS aircraft losses are, however, recorded for analysis.

(5) For air delivery of scatterable mine missions resource requirements are input into the constant data base as mission mix tables. There are a total of 27 mix tables, nine for each of three aircraft types; fixed wing high performance, transport/cargo, and rotary wing. At mission request time the DSL order contains an index to a specific mix table, thus defining the required resources. The availability of requested resources on the DSL specified airbase is considered for rotary wing missions only.

b. Approach. An air mission is treated in the model in seven major segments. Activities represented within these segments are described below.

(1) Allocation of Mission Resources. In response to a request for a DAF mission, resources required to accomplish the mission are allocated based upon the mission type. The quantities of resources required for each mission are pregame inputs which can be set at any desired level. Normally, however, a minimum of two attack helicopters is needed to undertake a mission, in which case the mission would not be flown if only one aircraft were available. Support is allocated within a hierarchy of support relationships from the airbase² nearest the target which is capable of meeting the mission type requirements. Should insufficient appropriate resources be available, an indication to that effect is made so that alternative means of attacking the target may be employed. The time required for aircraft preparation including arming, fueling, and crew briefing is determined from pregame input data, and the time when aircraft are to be airborne is determined. While on the ground at the airbase, either before or during mission preparation, DAF aircraft are vulnerable to enemy attacks direct at the airbase. In the case of a request for a CAS mission, the remaining portion of the sorties allocated for the current 6-hour period must equal or exceed the number required to accomplish the mission, for the mission to be flown. Otherwise, a reject message is issued, as in the DAF case. No other resource constraints are considered for CAS, nor are CAS aircraft vulnerable on the airbase.

2. The term airbase is used synonymously with air force airbase or helicopter port or pad.

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(2) Flight to the FEBA. When the aircraft are airborne, the formation flies from the airbase to a point near the front that is relatively safe from enemy air defense weapon systems. During this segment of the mission, no aircraft losses are considered. All aircraft leaving the airbase are assumed to arrive intact at the safe point. Consumptions of time and fuel are the only items considered during this mission segment (fuel is accounted for on DAF missions only).

(3) Penetration of Enemy Airspace. If the assigned mission requires penetration of enemy airspace, the third mission segment from the safe point to the target area is considered. Aircraft attrition due to enemy air defense weapons during this overflight of enemy airspace is calculated. The aircraft do not diverge from the assigned flight to the target area for the purpose of engaging enemy air defense weapons; thus, attrition to the aircraft and crews and consumption of fuel and time are considered on this mission segment.

(4) At the Target. Upon arrival of aircraft at the target area, the fourth mission segment, target release, is processed. For an air-to-ground attack mission, casualties may be inflicted on the attacking aircraft and its crew; on tanks, APCs, other vehicles, and personnel of the target unit; and upon air defense weapons in the vicinity of the target. For air delivery of mines, several passes along the barrier field are made to dispense the mines. Considerations are made as to the number of aircraft on the mission, aircraft velocity, dispensing rate, strip width, and type and quantity of mines to be released. Aircraft are vulnerable to air defense attrition while dispensing mines.

(5) Return to FEBA. Upon completion of the target strike, and if penetration of the enemy air space was required, the fifth mission segment returns the aircraft from the target area to a safe point within friendly airspace. As in the flight to the target, attrition of the aircraft and crew and consumption of fuel and time are considered.

(6) Return to the Airbase (DAF Mission Only). The sixth mission segment returns the aircraft from the safe point to the airbase from which the mission originated. As in the flight to the FEBA, no aircraft losses are considered in this mission segment.

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(7) Mission Completion (DAF Mission Only). The final segment is the mission completion. Aircraft landing, repair, and maintenance times are considered to determine when the aircraft will next be available for a new mission.

2. MODEL DESIGN:

a. Model Logic and Major Submodels:

(1) The basic logical flow of the Air Ground Engagement Model is predicated upon the automatic event sequencing logic fundamental to the DIVWAG system. The initial call to the Air Ground Engagement Model, in the form of a mission request, can be generated by either of two sources: DSL orders or the Intelligence and Control Model. A resource allocation submodel performs the necessary calculations to allocate aircraft to fly the mission, and schedules, as a DIVWAG event, the conditions that will pertain when the formation is airborne over the airbase. Each successive mission segment, as described in paragraph 1b, is then treated similarly; at the time the preceding mission segment is scheduled to end, the results of that segment are calculated, appropriate unit status file records are updated, and the time at which the next mission segment is to be completed is scheduled. Chapter 2 contains a discussion of the DIVWAG event sequencing logic. Figure IV-10-2 represents the logical flow within the Air Ground Engagement Model in response to calls from the major DIVWAG executive routine.

(2) The Air Ground Engagement Model contains five major submodels to treat the seven mission segments described in paragraph 1b. These include a resource allocation submodel (ATB) to treat the first mission segment, a friendly airspace overflight submodel (BTF) to treat the second and sixth mission segments, an en route attrition submodel (ENRATA) to treat the third and fifth mission segments, a target strike submodel (DRPEXC) to treat the fourth mission segment, and a mission completion submodel (BTA) to treat the final mission segment. The specifications of these submodels are found in paragraph 3.

b. Interactions with Other Models. The Air Ground Engagement Model interacts with the Intelligence and Control Model, the Combat Service Support Model, the Area Fire Model, the Suppression Model, and the Engineer Model.

(1) Interaction with the Intelligence and Control Model. A mission request from the Intelligence and Control Model contains information on the target's location, type, and activity, whether

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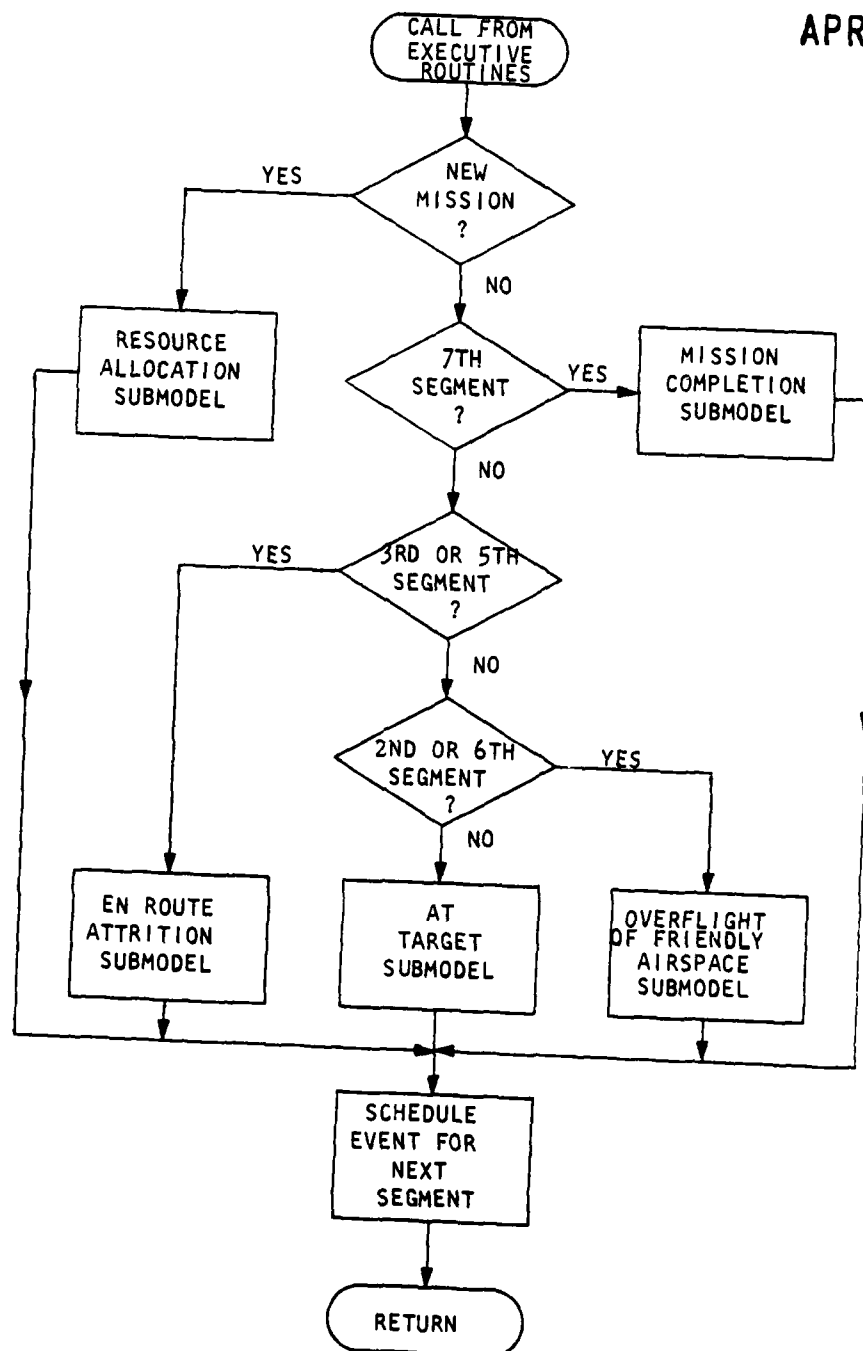


Figure IV-10-2. Air Ground Engagement Model Macroflow

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the target should be attacked by CAS or DAF, and whether a penetration of enemy airspace is required. If for some reason the Air Ground Engagement Model cannot perform the mission, a reject message is returned so that other firepower means may be directed against the target. A CAS mission request is denied if the available sorties for the current time period are less than the number required. For DAF the request is denied if the aircraft, munitions, personnel, or fuel required for the mission are not available. In addition, the Air Ground Engagement Model calls the Intelligence and Control Model at the beginning of each flight and again when the flight enters enemy airspace. These calls make the flight detectable by enemy sensors.

(2) Interaction with the Combat Service Support Model. The unit status file is the connection between the Air Ground Engagement Model and the Combat Service Support Model. The Combat Service Support Model resupplies aircraft, fuel, Army aerial fire support systems, munitions, and personnel to the airbases; and weapons, munitions, and personnel to the air defense units. This flow of men and materiel modifies the availability of personnel and equipment when an air mission is requested and the number of air defense weapons capable of firing at the aircraft when they penetrate enemy airspace.

(3) Interaction with the Area Fire Model. The Area Fire Model may assess losses to personnel and equipment on hand at an airbase or within an air defense unit. The effect is to modify the availability of items to fulfill requested DAF mission requirements and the number of air defense weapons that can fire against the aircraft.

(4) Interaction with the Suppression Model. Upon engaging the target unit, a suppression event is scheduled if the target is firing or moving. A delay of the movement or fire may result. The Suppression Model is described in Chapter 11.

(5) Interaction with the Engineer Model. For an air delivery of scatterable mines the Engineer Model is called at the end of each delivery pass along the minefield. The Engineer Model activates the minefield and increases its width and density as it receives information from the Air Ground Model that mines have been released.

c. Interaction with DSL. Three types of DSL orders interact directly with the Air Ground Engagement Model. A (MISSION IS) order requests an air attack on a specific target. A (RETAIN) order requests that a specified number of aircraft of a required type be reserved for undertaking one or more DSL-ordered attack helicopter missions. The

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(EMPLACE FIELD) order requests an air emplacement of mines on either a new or existing minefield.

(1) Mission Order. The mission order must, in all cases, specify the type (item code) and number of aircraft to be employed and the identity of the target to be attacked (target index number from the intelligence file of the division to which the airbase is assigned or attached). The desired attack time may be specified, at the gamer's option; otherwise, takeoff time will be the time the order is received.

(2) Translation of Mission Order. The information in the mission order is passed to routine ARCNRL to be processed. This processing yields the same type of mission request as generated by the Intelligence and Control Model (see paragraph b(1), above), except that the request is, in addition, flagged as originating in DSL, and the airbase to be used is specified, together with the type and number of aircraft in the flight.

(3) Retain Order. The retain order is applicable to DAF only and must specify the type (item code) and number of aircraft to be reserved. The retain order will generally be prefaced with a stay order which determines the point in time at which the reservation becomes effective. The retain order affects those aircraft which are on hand in the designated airbase at the time the order becomes effective as well as aircraft entering the unit at some future time. Reserved aircraft cannot be used to fulfill air mission requests generated by the Intelligence and Control Model. The quantity of reserved aircraft is reduced by the number flown on DSL missions. A second or subsequent retain order redefines the total number on reserve; unused reserve is not accumulated. An order to retain no aircraft will release any aircraft that may be on reserve status.

(4) Emplace Field Order. The emplace field order initiates an air delivery for a scatterable mine mission. The order specifies the supporting airbase, the number of aircraft desired, and the minefield mnemonic. The minefield mnemonic identifies the general aircraft type, flight altitude, and an index into the mission resources mix table.

(5) Model Implementation. Implementation of these DSL orders within the Air Ground Engagement Model is further described in paragraph 3b, below.

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d. Environment:

(1) The Air Ground Engagement Model uses five DIVWAG environmental parameters: the visibility index, the terrain roughness and vegetation index, the forestation index, and the times, beginning of morning nautical twilight (BMNT), and ending of evening nautical twilight (EENT).

(2) The visibility index is combined with BMNT and EENT to form a joint weather-light index, which is limited to four conditions. Visibility is defined in the Air Ground Engagement Model to be either good or poor. Visibility is good if the visibility index is greater than five; otherwise, it is poor. Light is determined by BMNT and EENT. Any time between BMNT and EENT is considered daytime. Other times are considered nighttime. Thus, the four weather-light conditions used by the Air Ground Engagement Model are: day, good visibility; day, poor visibility; night, good visibility; night, poor visibility. Roughness, vegetation, and forestation are used in the model to degrade the effective number of air defense weapons that fire at overflying aircraft.

3. SUBMODEL SPECIFICATIONS:

a. General. The Air Ground Engagement Model performs a relatively limited number of calculations, generally of a geometric or a probabilistic nature. Most results generated by the model are the result of a direct look-up of data contained in an extensive data base, which must be prepared prior to the execution of simulated activities. Contents and form of the data tables are indicated within the descriptions of the model subroutines, where such information is essential to an appreciation of the model logic. Detailed data specifications are found in Appendix A to this chapter.

b. Resource Allocation Submodel:

(1) Logical Flow. The basic logical flow of the Resource Allocation Submodel is shown in Figure IV-10-3. The incoming request for an air mission originates through DSL or automatically by the Intelligence and Control Model.

If the air mission request is for delivery of scatterable mines, it must originate through DSL only. The DSL order will provide the minefield identification and a 4-character munition mnemonic which identifies aircraft type, mix of mission resources, required constraints, and the mission flight altitude.

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AUTOMATIC MISSION

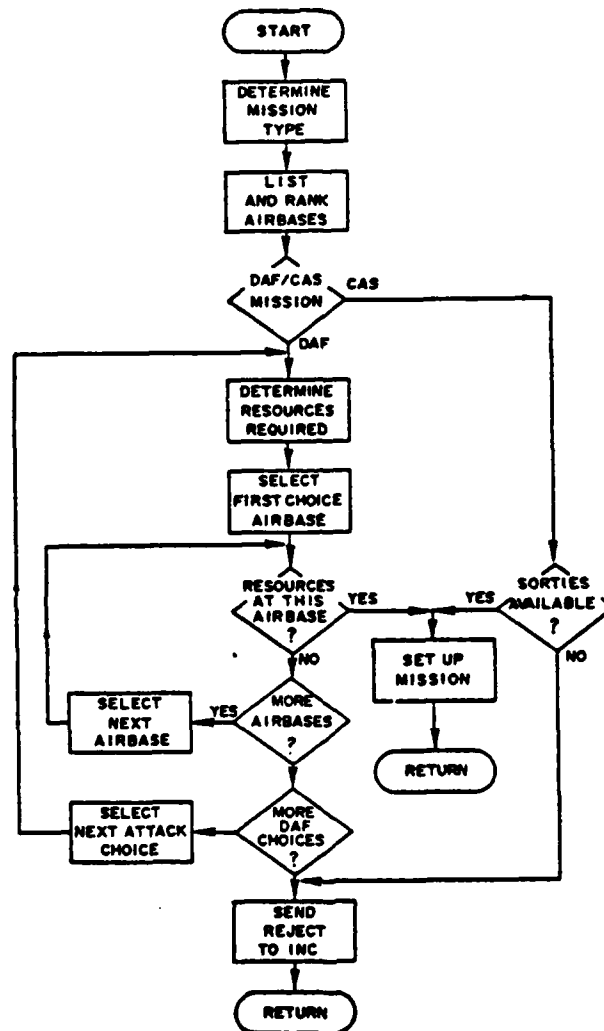


Figure IV-10-3. Resource Allocation Submodel Logical Flow (Continued)

DSL MISSION

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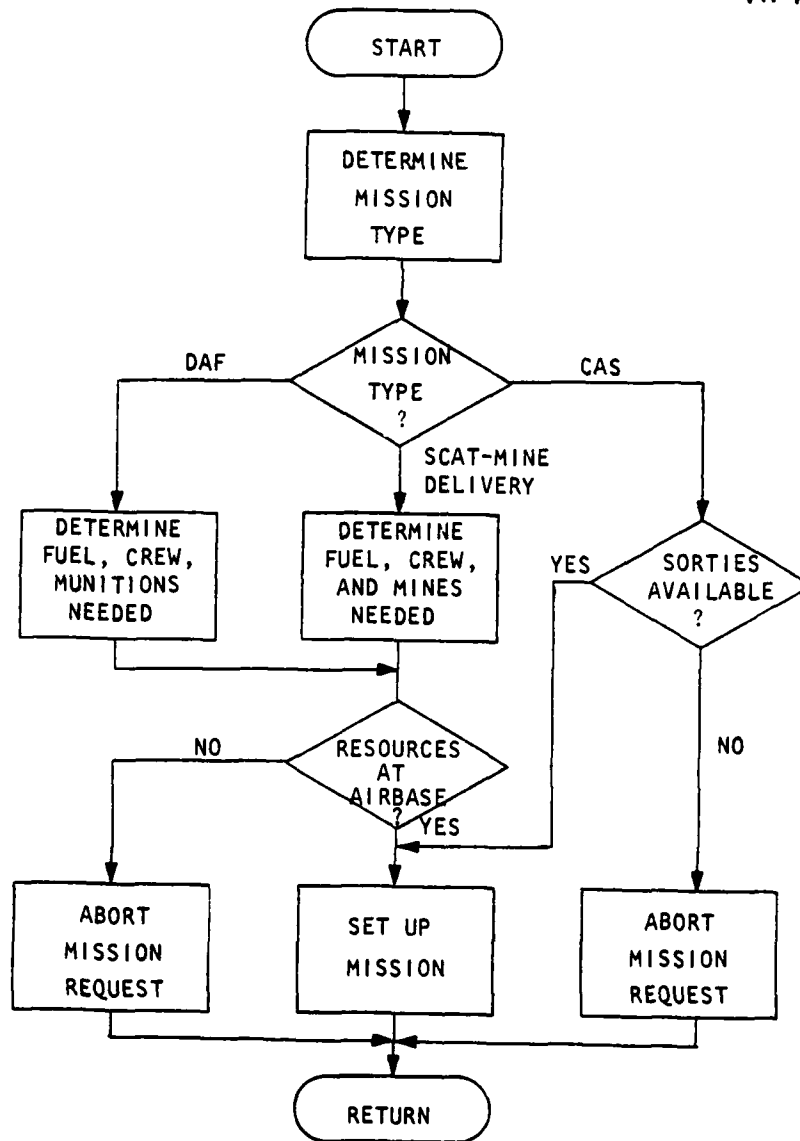


Figure IV-10-3. Recourse Allocation Submodel Logical Flow (concluded)

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If the mission request is for an air-to-ground attack, both DSL and automatic requests contain the estimated type of target unit, its estimated location and activity, and whether penetration of enemy airspace is anticipated. Automatic requests specify whether CAS or DAF is to be employed, whereas DSL-ordered requests specify the precise airbase, aircraft type, and number of aircraft to be used. The weather-light condition is then obtained and added to the information from the incoming request. This information is then used to translate the incoming request into one of the 40 possible mission types listed in Figure IV-10-1. Since the Intelligence and Control Model can identify 11 types of target units, while the Air Ground Engagement Model considers only five, a translation of target types is necessary. Types are equated by the model as follows:

<u>Intelligence and Control Type</u>	<u>Air Ground Engagement Type</u>
Infantry	Infantry
Mechanized infantry	Mechanized infantry
Armor	Tank
Reinforced task force	Tank
Tube artillery	Artillery
Missile artillery	Artillery
Air defense guns	Artillery
Air defense missiles	Artillery
Airbase	Airbase
Engineer	Infantry
Unknown	Infantry

For each of the 40 possible mission types, an input table specifies the typical resource requirements for attack of a typical size target unit.³ For CAS, only the required number of sorties is specified. For DAF, the required number of aircraft, personnel, munitions, and gallons of fuel is specified. If the request was originated automatically by the Intelligence and Control Model, the tabulated resource requirements are used. If the request originated in DSL, however, the type and number of aircraft are DSL-specified, and in this case, a ratio is struck between the number of aircraft specified by DSL and the number specified in the input table. This ratio is used in the case of DAF to modify tabular requirements for personnel, munitions, and fuel commensurate with the number of aircraft specified in the DSL. A determination of resource availability is then made as described in the next paragraph. If resources are not available for an automatically requested mission, a mission reject message is returned to allow for targeting by other fire support means. If resources are available, they are allocated for the assigned mission; and the necessary parameters for further simulation of the mission are generated.

3. Company size has been used to date.

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(2) Resource Availability. The process of determining resource availability depends upon whether the request was DSL or originated automatically, and whether DAF, CAS, or air delivery of scatterable mines is to be employed.

(a) Automatic DAF Mission Request. For each of the 40 mission types, both a first and a second choice of DAF aircraft type/munition types may be specified as part of the game constant data base, input before initiation of the game. For each choice, the minimum number of aircraft, personnel, munitions, and fuel (gallons) required to undertake the mission is specified. Each airbase is checked to see if the minimum first choice resource requirements are available at that airbase. (Resources on hand less those reserved for DSL missions are considered available for automatic DAF missions.) Airbases placed in direct support of the requesting unit are selected first and are ranked by proximity to the target. That airbase, if any, which is nearest the target and has sufficient available resources is chosen to mount the mission. If the mission request has not been satisfied, the process is repeated for those airbases in a general support role. If still no airbase qualifies, the process is repeated in an effort to apply the second DAF attack choice. If no airbase can meet either requirement, a mission reject message is generated to permit scheduling of other fire support means.

(b) DSL-Originated DAF Mission Request. For a DSL-originated DAF mission request, the type and number of aircraft desired to undertake the mission are specified by the gamer. By the process described in paragraph b(1), above, the request is translated to one of the 40 mission types, and the tabular resource requirements for that mission type are adjusted according to the number of aircraft specified in the DSL request. The DSL request also specifies the airbase from which the resources are to come. All resources on hand at that airbase are considered available for a DSL mission. If resources on hand meet requirements, the mission is flown, and the number of aircraft flown is subtracted from those reserved, if any. If required (minimum) resources are not on hand, the mission is not flown, and a message is printed.

(c) DSL and Automatic CAS Mission Request. As part of the game data base, the number of CAS sorties available to each force, in four time blocks of 6 hours each starting at 2400, is input. These numbers may be changed between game periods if so required. For the Blue force, general availability of all-weather aircraft is assumed; for the Red force, two sortie allocations are made; one for all-weather aircraft and one for aircraft limited to operations under good weather-light conditions. In response to a request for a CAS

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mission, the number of sorties left in the current time block is checked. If all allocated sorties have been flown, a mission reject message is generated. The model does not permit good-weather-light sorties to be used under other weather-light conditions.

(d) DSL Scatterable Mine Delivery Request. A four character munition mnemonic, provided through DSL, is the key to the resource requirements for the requested mission. The first character identifies the general aircraft type as; A-fixed wing high performance, C-transport/cargo type, H-rotary wing. The fourth character is an integer between 1 and 9 which is an index to a specific resources mix table. Up to 27 mission mix tables are gamer loaded as part of the constant data base. Each mix table contains the desired mission resources which include the item code of the aircraft, crew and fuel per aircraft, and up to three pairs of mine data consisting of the mine item code and its desired quantity. The airbase, also specified in the gamer DSL order, is then checked for the availability of the desired resources. Resource limitations and constraints are not placed on missions involving A or C type aircraft. A rotary wing mission may be flown with less than the desired resources as the following limitation checks are made by the model; the desired number of aircraft may be reduced if an insufficient quantity of aircraft, fuel or personnel exist at the airbase, the total quantity of each mine type per aircraft will be proportionally reduced to the number of aircraft that actually participate on the mission. The mission request will be rejected if aircraft are constrained to zero or there is not at least 70 percent of any of the desired mine type quantities available.

(3) Resource Allocation:

(a) DAF Mission Requests. In addition to specifications of the minimum mission requirements described in paragraph b(2)(a), above, the game data base contains an identically structured table, which specifies the maximum amounts of the same resources that may be allocated for a given mission type. Once an airbase capable of meeting the minimum requirements is found, resources are allocated from those available at the airbase up to the maximum levels specified. Some amount less than the maximum may be allocated if the maximum exhausts the airbase's currently available resources.

(b) CAS Mission Requests. CAS resources required to perform a given type mission are specified in the game data base only in terms of types and numbers of aircraft sorties. If required CAS sorties are available, the specified mission will be flown.

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(c) Scatterable Mine Mission Requests. Scatterable mine mission resources as specified in the constant data base mix tables are allocated to the mission unit after its creation in the Resource Allocation Submodel.

(4) Preparation Time. For automatic missions only, the Resource Allocation Submodel determines the time when aircraft are to be airborne.⁴ This time is determined by adding preparation time to the current game time. Preparation time is obtained from the game data base, based on the type and number of aircraft allocated to the mission. These data are intended to represent typical times to brief crews, coordinate supporting fires, warm up aircraft, take-off, and make up formations. Aircraft assigned to DAF missions are vulnerable to enemy attacks on the airbase until airborne. Attacks on CAS airbases are not considered. Preparation times are not considered for scatterable mine delivery missions, and the mission unit is not vulnerable to enemy air attacks while at the airbases prior to take-off.

(5) Continuation of Mission. To accomplish further simulation of the mission, a unit status file record containing the mission unit is constructed by the Resource Allocation Submodel. This procedure is a matter of programming convenience, done to facilitate keeping track of the aircraft allocated to the mission as they progress through the remaining mission segments.

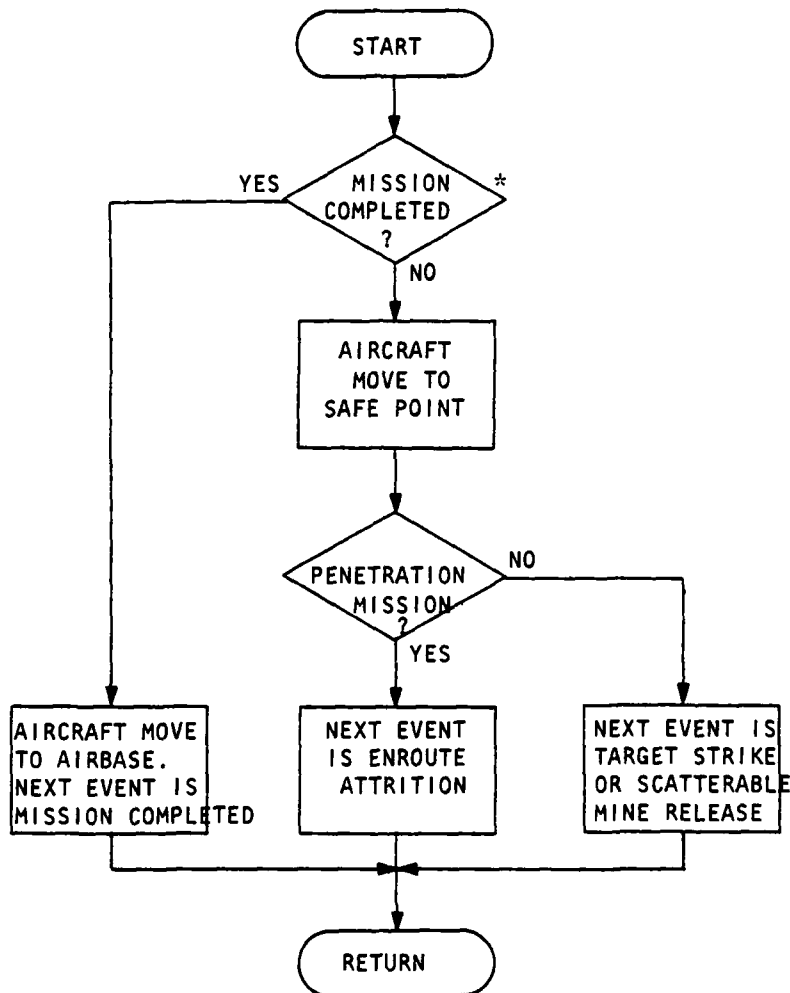
c. Friendly Airspace Overflight Submodel:

(1) Logical Flow. The basic logical flow of the Friendly Airspace Overflight Submodel is shown in Figure IV-10-4. The submodel determines the time the mission unit will reach a safe point, located near the FEBA, on the outgoing leg of a mission; or the time the aircraft will arrive at the home airbase from the same safe point on return from a mission. No attrition, maintenance, or air mishaps are treated during these segments of the mission.

(2) Calculation of the Safe Point. A safe point marks the simulated transition from friendly to enemy airspace. The point is developed by first constructing a line through the location of the specified target perpendicular to the FEBA. Then a line parallel to the FEBA, through the forwardmost enemy maneuver battalion, is constructed. The safe point is located X meters from the intersection of these lines, in a direction normal to the FEBA and toward

4. Take-off time for DSL missions is determined by the DSL order (see paragraph 2c(1)).

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*Mission completed indicates attack of target is completed but aircraft are not back at the airbase.

Figure IV-10-4. Friendly Airspace Overflight Submodel Logical Flow

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the friendly area from the target. The distance, X , is determined from the effective range of enemy air defense weapons under the prevailing visibility conditions and the typical depth of deployment of these weapon systems. A schematic of the geometry involved is shown in Figure IV-10-5. The necessary calculations, documented in the following subparagraphs, require use of the slope of the battlefield and the list of forward maneuver battalions described in Chapter 5 of this section.

(a) The first calculation is of a safe distance, X_s , from the center of the forwardmost enemy unit to which an aircraft can fly and not be endangered by enemy air defense weapons. The safe distance, X_s , is found by:

$$X_s = R - D, \text{ if } R > D$$

$$X_s = 0, \text{ if } R < D \quad (\text{IV-10-1})$$

where:

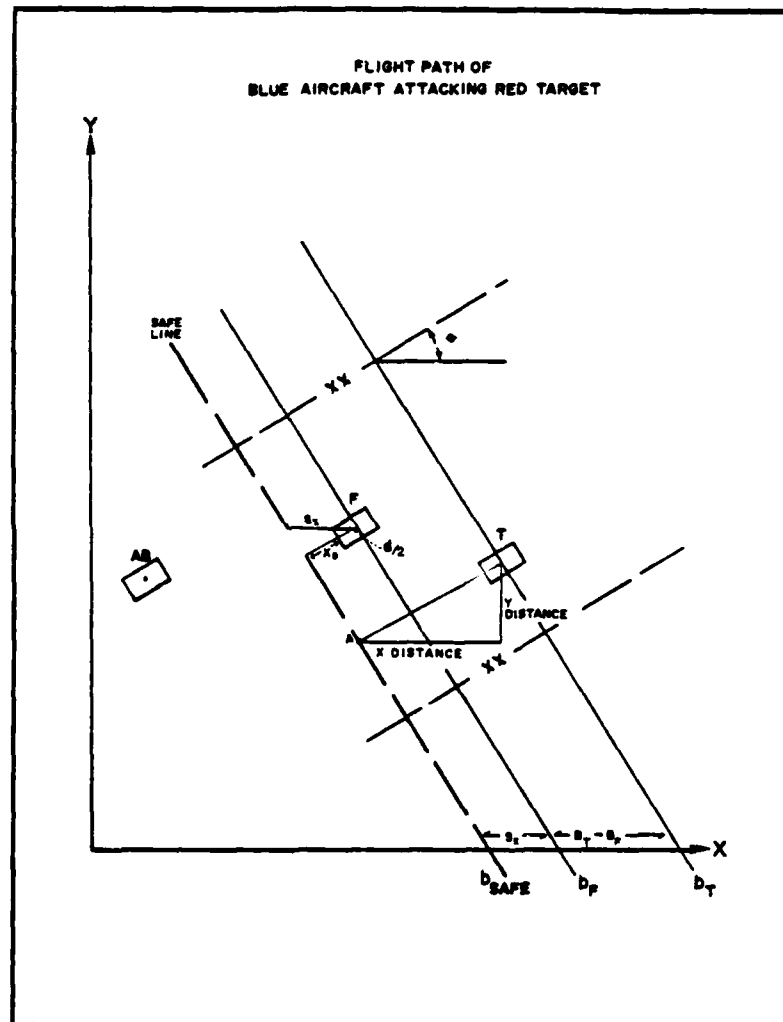
R = greatest effective range under prevailing visibility conditions of any air defense weapon type in the force.

D = typical deployment distance behind FEBA of that weapon type with effective range R .

(b) The X intercept of a line parallel to the FEBA and passing through the point with coordinates (x,y) is found by Equation IV-10-2:

$$b = x + y \cdot s \quad (\text{IV-10-2})$$

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**Figure IV-10-5. Schematic for Calculating Safe Point,
Blue Aircraft Attacking Red Target**

where:

b = desired X intercept

s = slope of the battlefield, or $\tan \theta$ in Figure IV-10-5.

This equation is used to determine the X intercept of lines through the centers of all forward maneuver units. The unit with X intercept that is the closest to the X intercept of the FEBA is the forwardmost maneuver battlaion. The same equation is used to calculate the X intercept of a line parallel to the FEBA through the target coordinates.

(c) A determination is made whether the target or the forwardmost maneuver battalion is closer to the FEBA. The safe distance is increased by one-half the depth of the forward unit to give a safe distance from the unit front. The horizontal projection of this distance on the X axis is calculated using Equation IV-10-3:

$$S_X = (X_s + d/2) / \cos \theta \quad (\text{IV-10-3})$$

where:

S_X = horizontal projection of safe distance

d = depth of forward unit

X_s = defined in Equation IV-10-1

θ = see Figure IV-10-5.

(d) The distance, $XDIST'$, from the X intercept of the safe point to the X intercept of the target is the sum of S_X and the distance between the X intercepts of the lines through the target and forwardmost unit, developed using Equation IV-10-2. This distance may be calculated as:

$$XDIST' = S_X + |b_T - b_F| \quad (\text{IV-10-4})$$

where:

S_X = safe distance, from Equation IV-10-3

b_T = X intercept of line parallel to FEBA passing through target

b_F = X intercept of line parallel to FEBA passing through forwardmost unit.

(e) The actual distance from the safe point to the target, TDIST, and the projection of this distance on the X and Y axis are given by Equations IV-10-5 and IV-10-6:

$$TDIST = XDIST' * \cos \theta \quad (IV-10-5)$$

$$YDIST = |TDIST * \sin \theta| \quad (IV-10-6)$$

$$XDIST = TDIST * \cos \theta \quad (IV-10-7)$$

where a current limitation is that θ must be defined to rotate from -90° through 0° to 90° .

(f) The coordinates of the safe point are calculated depending on the relative positions of b_T ; the X intercept of the safe line, b_{SAFE} ; and the slope of the battlefield:

$$P_X = T_X + XDIST, \text{ if } b_T \leq b_{SAFE} \quad (IV-10-8)$$

$$P_X = T_X - XDIST, \text{ if } b_T > b_{SAFE} \quad (IV-10-9)$$

$$P_Y = T_Y + YDIST \quad (IV-10-10)$$

if slope is greater than 0 and b_T is less than b_{SAFE} or if slope is less than or equals 0 and b_T greater than b_{SAFE} ; and

$$P_Y = T_Y - YDIST \quad (IV-10-11)$$

if slope is greater than 0 and b_T greater than b_{SAFE} or if slope is less than or equals 0 and b_T is less than b_{SAFE} , where:

P_X = X coordinate of safe point

P_Y = Y coordinate of safe point

T_X = X coordinate of target

T_Y = Y coordinate of target

$XDIST$, $YDIST$, b_T , b_{SAFE} , and slope are previously defined.

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ARMY COMBINED ARMS COMBAT DEVELOPMENTS ACTIVITY FORT--ETC F/O 15/7
DIVWAS MODEL DOCUMENTATION. VOLUME II. PROGRAMMER/ANALYST MANUA--ETC(U)
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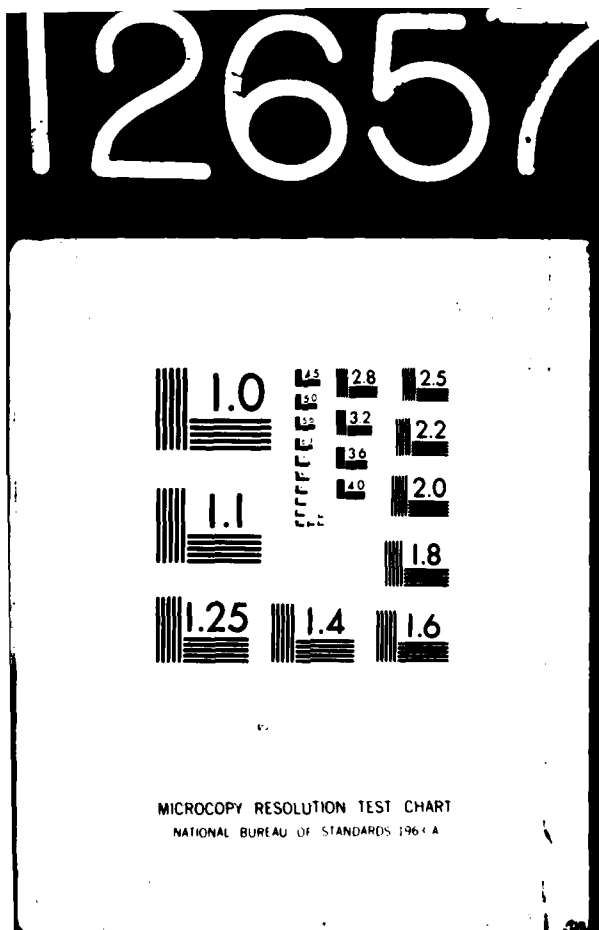
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(3) Calculation of Flight Time. Cruise speeds for aircraft in various weather conditions are part of the game data base. These speeds are applied in the flight from the airbase to the safe point. Cruise speeds are applied to the straight line segment from the airbase to the safe point, and the required flight time is calculated by use of Equation IV-10-12. The same time and distance are used for the outgoing and incoming legs of a mission.

$$T = D / S \quad (IV-10-12)$$

where:

T = time of flight

D = distance

S = airspeed.

d. En Route Attrition Submodel:

(1) General. This submodel calculates aircraft losses that may result from ground fire for any aircraft flight over enemy dominated terrain. Aircraft losses are classified into four categories depending on the type and severity of the damage. This submodel is called when DAF, CAS, and scatterable mine missions are required to penetrate enemy airspace. It determines aircraft losses inflicted by enemy air defense weapons as the aircraft move from the safe point to a point where attack of the target begins. The submodel is also used to determine aircraft losses that occur as the formation returns to friendly territory after mission accomplishment. Flight time is also calculated.

(2) Submodel Logic. For a detailed description of the in-flight attrition submodel logic please refer to In-flight Attrition, Airmobile Model, Chapter 15. All references to airmobile flights and escort aircraft may be interpreted as an air ground mission unit flight.

(3) Aircraft Loss Categories. Four kill categories are considered in the model: A-kill (catastrophic kill), B-kill (forced landing), C-kill (mission abort), and D-kill (hit, but minor damage). When an aircraft suffers an A-kill, it crashes because of the damage inflicted by the defending air defense weapons and is not recoverable for future use. Type B-kill forces the aircraft to land (powered or unpowered) because of damage, or forces it to make a precautionary

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landing because of an automatic warning signal indicating trouble. If the downed aircraft has penetrated enemy airspace, it is not recoverable and is considered destroyed. If no penetration of hostile territory occurred, the downed aircraft is recovered after an appropriate delay time. It can then be used in future engagements. When a type C-kill occurs, the aircraft is forced to discontinue its mission because of damage to the aircraft or because of a pilot or copilot casualty. In this case, the aircraft immediately breaks off its engagement with the target and returns to its base. Type C-kills are susceptible to additional attrition from air defense weapons on the return trip. Aircraft suffering type D-kills are considered able to complete their mission. A repair time is imposed on them when they return to their airbase.

(4) Calculation of Flight Time. Flight time in enemy airspace is calculated for flight from the safe point to the target and return from the target to the safe point in the same manner as described in paragraph c(3), above. Flight time from takeoff to target establishes the time of target attack. In the case of DAF, total flight duration affects the availability of DAF resources for subsequent mission.

e. At Target Submodel:

(1) General. This submodel is divided into two segments which simulate the arrival of aircraft at the target location for either an air attack of a ground target, or the air release of scatterable mines.

(2) Target Strike. This segment determines outcomes of engagements between aerial attackers and ground based weapons in terms of aircraft losses, munition expenditures, and losses inflicted on the ground target. The detailed interactions of the aircraft and ground forces are not explicitly simulated. Rather, the complete engagement results are extracted from a series of lookup tables, which are prepared pregame from results obtained from high resolution simulations for engagements under similar conditions (Reference 4). Prior to entering the lookup tables to determine engagement results, the number of aircraft surviving the flight to the point from which the target will be attacked is compared with the abort criterion (minimum number of aircraft) to see if the mission will be performed. If the mission is aborted the aircraft are returned to the mission safe point without first attacking the target. A mission is not aborted if the mission did not require some penetration of the enemy airspace.

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(a) Engagement Result Tables. Input to the engagement result tables consists of 228 situations. These situations include five target types under each of the four weather-light conditions of daytime, good visibility; daytime, poor visibility; nighttime, good visibility; and nighttime, poor visibility. Targets include a tank unit, a mechanized infantry unit (motorized rifle unit), an infantry unit, an artillery unit, and an airbase. These five target types and four visibility conditions define the 20 mission types shown in Figure IV-10-1. For each mission type these situations consist of one of three attack aircraft/munition mixes. Five postures are possible for each mission type against the tank unit, the mechanized infantry unit, and the infantry unit targets (assembly area, attack, defend, on road, delay). These three target types account for 180 of the 228 situations in the result tables (12 mission types, 3 aircraft/munition mixes, 5 postures). For the artillery unit target three postures are used: on the road not firing, firing artillery tubes, and firing missiles, giving a total of 36 situations (4 mission types, 3 aircraft/munition mixes, 3 postures). For the airbase as a target, posture is not considered; hence, this case adds 12 situations (4 mission types, 3 aircraft/munition mixes). The contents of the engagement results table are shown in Figure IV-10-6. Losses to attacking aircraft, defending air defense weapons, and the target itself are all contained in the 54 information items.

(b) Use of Engagement Result Tables:

1. Data in the engagement result table are adjusted to account for the specific number of aircraft that attack the target and the true strength of the enemy force in the target area. The fractional number of effective aircraft remaining if there was penetration is divided by the number of aircraft upon which the data were derived to get an adjustment factor. This adjustment factor is further modified by multiplying it by the enemy percent strength. This total adjustment factor is used as a multiplier of the tabular data in the engagement result table.

$$\text{RESULT} = \frac{n}{N} \cdot \frac{P}{A} \cdot E_1 \quad (\text{IV-10-13})$$

where:

n = number of aircraft remaining on the mission when the formation reaches attack point; A-, B-, and C-type kills have been attrited

Field	Description	Field	Description
	<u>A-kills</u>		<u>Tanks killed</u>
1	by < 23mm	29	by guided missile
2	by 23mm		<u>APCs killed</u>
3	by > 23mm	30	by guided missile
4	by SAM	31	by other
	<u>B-kills</u>		<u>Vehicles killed</u>
5	by < 23mm	32	by guided missile
6	by 23mm	33	by other
7	by > 23mm		<u>Personnel killed</u>
8	by SAM	34	
	<u>C-kills</u>		<u>Air defense weapons killed</u>
9	by < 23mm	35	type 1
10	by 23mm	36	type 2
11	by > 23mm	37	type 3
12	by SAM	38	type 4
	<u>D-kills</u>	39	type 5
13	by < 23mm	40	type 6
14	by 23mm	41	type 7
15	by > 23mm	42	type 8
16	by SAM	43	type 9
	<u>Aerial munition expended</u>		<u>Air defense munition expended</u>
17	type 1	44	type 1
18	type 2	45	type 2
19	type 3	46	type 3
20	type 4	47	type 4
21	type 5	48	type 5
22	type 6	49	type 6
	<u>Aerial munition lost</u>	50	type 7
23	type 1	51	type 8
24	type 2	52	type 9
25	type 3		<u>Number of aircraft</u>
26	type 4	53	flying mission
27	type 5		<u>Duration of engagement</u>
28	type 6	54	minutes x 10 ²

Figure IV-10-7. Engagement Results Table

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N = number of aircraft on which this particular situation
in the engagement result table is based

P = present strength of the target unit

A = TOE strength authorized for the target unit

E_i = entry i in the engagement result table.

Each of the first 52 items in the engagement result table is pre-multiplied as shown in Equation IV-10-13.

2. After the results of the air strike have been determined, the attrited air defense equipment is distributed among the target unit and its supporting air defense units. For each air defense weapon type, losses are distributed proportionately to the number of weapons in a unit. To determine the supporting units, a circle with its center at the coordinates of the target unit is drawn. The radius of this circle is twice the standoff distance, y, for the engagement. All enemy units containing air defense weapons whose coordinates fall within the circumference of this circle are considered to be supporting units.

(3) Mine Release. This segment of the At Target Submodel simulates the release and distribution of mines over the barrier trace. Given the desired depth of the minefield a mid-path is computed as parallel to the trace and 1/2 the desired depth behind it. The mid-path is the flight path of the aircraft during the dispensing action. If the flight path is in hostile territory the aircraft are vulnerable to ground weapon attrition as portrayed by the Ground to Air Attrition Submodel.

The velocity of the aircraft is computed so as to distribute the mines over the field at a given density:

$$IVEL = (DISPRT \cdot W \cdot IDEPTH) / (ISTRIP \cdot M) \quad (IV-10-14)$$

where:

DISPRT = dispensing rate (mines/minute/aircraft)

W = barrier/mine-field length

IDEPTH = desired depth of minefield

ISTRIP = strip width/aircraft

M = total mines.

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The velocity is further constrained so as to not exceed the minimum or maximum capabilities of the aircraft.

Only a constant number of mines may be released per pass for a constant velocity and dispensing rate. A total number of passes must be computed for the release of all mines:

$$IPASS = (M \cdot IVEL) / (TACR \cdot DISPRT \cdot W) \quad (IV-10-15)$$

where:

TACR = total number of aircraft remaining after flight to barrier trace.

The flight time required for each pass is:

$$TIME = DISTI / IVEL \quad (IV-10-16)$$

where:

DISTI = the length of the flight path.

The flight altitude for this mission is gamer input in the game constant data base, and is referenced by an altitude index also gamer input through DSL.

At the end of each flight pass, fuel consumption is computed and subtracted from the mission unit. If any attrition to aircraft occurred while in flight a proportional amount of aircraft resources is computed and deducted from the mission unit. The amount of mines delivered for this pass by surviving aircraft is:

$$TOTDEL = TACR \cdot DISPRT \cdot W / IVEL \quad (IV-10-17)$$

where:

TACR = total aircraft remaining after pass.

The total path width for each pass is computed as:

$$KKK = ISTRIP \cdot TACR \quad (IV-10-18)$$

The path width in addition to the total mines delivered is sent to the Engineer Model so that mine emplacement for this pass may be recorded.

If this is not the last pass, the next pass is scheduled; otherwise, an event is scheduled for the return of the aircraft to either the airbase or the mission safe point, as appropriate.

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(4) Engineer Model Interaction. At the end of each pass along the flight path vital information concerning this portion of the minefield emplacement is forwarded to the Engineer Model. After the initial pass the minefield becomes active and has a width and density as provided by the incoming information. On subsequent passes the density will remain constant with the field width increasing until the desired depth is reached. At this point any further passes will only increase the minefield density.

(5) Return. After exiting from the Target Strike or Mine Release segment, the remaining aircraft are flown back to the airbase or the mission safe point, as appropriate.

f. Mission Completion Submodel (DAF Aircraft Only). When the aircraft have arrived at a point over the airbase and are ready to land, the Mission Completion Submodel is called. This subroutine determines the landing time required, which includes taxi time to the aprons used for parking or storing, and determines the time when each of the returning aircraft (or recoverable aircraft) can be listed as available for another mission. Differences in airfield capabilities are not considered. It is assumed that the base capabilities are compatible with the aircraft types. Generally, the times in the table will permit aircraft with no damage to be available as soon as the required postflight maintenance time for the number of flying hours has passed. The maintenance downtime includes refueling and rearming. Repair time delays will be imposed on C- and D-type kills. The time for those B-kills that occurred in nonpenetration type missions reflects the total recovery and repair time.

4. HISTORY TAPE OUTPUT. The Air Ground Engagement Model writes the following event record onto the period history tape.

<u>Record Type</u>	<u>Title</u>	<u>Frequency</u>
211	Air Ground Mission Request	One record for each mission request received.
221	Air Ground En-Route Attrition	One record for each mission unit flying to and from the target.
231	Air Ground Target Engagement	One record for each mission unit/target unit engagement.
241/242	Air Ground Target Assessment	One pair of records for each mission unit/target unit engagement.

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The detailed description of the record formats is presented in paragraph 2c of Appendix A to Chapter 1 of Section VI.

5. PERIOD TERMINATION. Period termination does not force the termination of an on-going air mission. Mission segments scheduled for a time beyond the current period will automatically be carried forward and executed at their scheduled time in a subsequent period.

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APPENDIX A

AIR GROUND ENGAGEMENT MODEL INPUT REQUIREMENTS

1. INTRODUCTION. Air to ground or ground to air engagements in DIVWAG can be assessed for attrition and casualty results using the Air Ground Engagement Model. Included in the aerial delivery systems are: direct aerial fires, fixed wing aircraft, and high performance jet aircraft in close air support roles. Air missions are automatically requested by the Intelligence and Control (INC) Model of DIVWAG or directed by DSL orders. This appendix sets forth instructions for entering constant data into the model files prior to commencement of game play. Only the unique data elements that are constant throughout the play of the problem are presented in the following paragraphs. Data elements that are common to several models are to be found in other documentation.

2. CARD FORMAT RELATIONSHIPS:

a. To use the Air Ground Engagement Model, data must be entered in 13 different card formats. Descriptions of these card types have been divided into four categories.

b. Data are loaded on two files: data file 26, Air Ground, and data file 27, Engagement Results. Data file 26 is used in all portions of the model, and is denoted by the number 26 in columns 73 and 74 of the appropriate card formats. Data file 27 is only used in the routine that simulates the actual air strike of the ground target, and is denoted by the number 27 in card columns 73 and 74.

c. The three major dependency type variables for data file 26 are mission type, aircraft type, and air defense weapon type. These three items constitute the backbone structure around which the file 26 data for the Air Ground Engagement Model is formed. Mission type dependent data are input on card formats identified by the number 01 in card columns 75 and 76. Card formats structured about the aircraft type to be used on the mission will have the number 02 in columns 75 and 76. Card formats with the number 03 in columns 75 and 76 will denote data entries built around the air defense weapon type.

d. Columns 1 and 2 on each of the 13 different card formats are used for the same purpose. Column 1 is used to identify the card type. It must always have an integer value between 1 and 4 on preprinted forms; this value should not be changed. This field will be more fully explained in the individual card format descriptions. Column 2 must contain either an R or a B. The letter R designates that the data pertain to the Red force. Similarly, the letter B designates that the data pertain to the Blue force. If neither letter is inserted in column 2, the card will be rejected by the edit program.

3. DATA INPUT BY MISSION TYPE (2601):

a. General:

(1) Twenty mission types have been defined for use in this model. These mission types are a function of visibility code and target type. Figure IV-10-A-1 shows the four values that the visibility code may have. The five target types are

- . Tank company
- . Mechanized infantry or motorized rifle company
- . Artillery battery
- . Infantry company
- . Airbase.

Within each target type the four visibility codes are used making a total of 20 mission types.

Visibility Code	Description
1	Daytime, good visibility
2	Daytime, poor visibility
3	Nighttime, good visibility
4	Nighttime, poor visibility

Figure IV-10-A-1. Visibility Codes

(2) There are up to three aircraft/munition mixes that can be used for each mission type. Mix 3 is used to designate requirements for a close air support mission. Mixes 1 and 2 designate requirements for delivery of direct aerial fires. If the target of the air strike is a hard target; i.e., armored or mechanized unit, the first choice direct aerial fire requirement might be a Cobra loaded with 30mm rounds and TOWs. This would be mix 1. The second choice direct aerial fire would be a Cobra loaded with 40mm rounds and 2.75-inch rockets, which would be mix 2. On the other hand, if the target is soft; i.e., an infantry unit, the first choice (mix 1) direct aerial fire might be a Cobra loaded with 40mm rounds and 2.75-inch rockets. Second choice direct aerial fire (mix 2) in this case would be 30mm rounds and TOWs. The TOWs would be carried in hopes that a tank or an APC would be in the soft target

(3) A maximum of nine aircraft types, each having a maximum of six munition types, is possible. These restrictions must be borne in mind throughout the ensuing discussion of data preparation.

(4) Four card formats are included in the mission type category. They are minimum and maximum aircraft requirements for mission performance; minimum ammunition and personnel requirements for mission performance; maximum ammunition and personnel requirements for mission performance; and aircraft mission preparation delay times. These card formats are identified by the number 2601 in columns 73 through 76.

b. Aircraft Requirements for Mission Performance:

(1) General. When an air strike is requested, the requirements for aircraft, ammunition, fuel, and personnel must be determined. These requirements are a function of time of day, visibility conditions, target type, and whether a penetration of enemy air space is to occur. Each combination of these variables is associated with one of the 20 mission types.

(a) When a mission request is for close air support, the number of aircraft must be specified for each possible mission type. A close air support mission will always be flown provided enough sorties are available.

(b) For the delivery of direct aerial fires, both a maximum and a minimum quantity of each equipment item to be loaded on the aircraft must be specified. If the minimum amount of each and every item is not available on at least one airbase, the mission request will be denied. If more than the maximum amount of any item is available on the selected airbase, only the maximum amount would be taken on a mission. If the quantity of an item is more than the minimum, but less than the maximum, then the amount available will be loaded for the mission. For close air support missions only the maximum amount need be specified.

(2) Minimum and Maximum Aircraft Requirements for Mission Performance (Card Type 1). For each mission type, aircraft requirements are input in card type 1 (see Figure IV-10-A-2). There are seven sections to this card: card type, force designator, mission type, penetration indicator, and three sections for aircraft/munition mix.

(a) Card Type (Column 1). The number 1 is preprinted; do not change.

(b) Force Designator (Column 2). Insert R or B depending on whether data pertain to Red or Blue force.

(c) Mission Type (Columns 3-4). Insert the appropriate mission type code from Figure IV-10-A-3. This will be a two-digit integer between 01 and 20.

(d) Penetration Indicator (Column 5). This column is used to designate penetration status. Insert the integer 1, 2, or 3. A code of 1 indicates that the requirements of aircraft and fuel stated in this card pertain to the mission type specified in columns 3-4 only if no penetration of

Code	Description of Target
01	Tank company, daylight, good visibility
02	Tank company, daylight, poor visibility
03	Tank company, night, good visibility
04	Tank company, night, poor visibility
05	Mechanized infantry (motorized rifle) company, daylight, good visibility
06	Mechanized infantry (motorized rifle) company, daylight, bad visibility
07	Mechanized infantry (motorized rifle) company, night, good visibility
08	Mechanized infantry (motorized rifle) company, night, poor visibility
09	Artillery battery, daylight, good visibility
10	Artillery battery, daylight, poor visibility
11	Artillery battery, night, good visibility
12	Artillery battery, night, poor visibility
13	Infantry company, daylight, good visibility
14	Infantry company, daylight, poor visibility
15	Infantry company, night, good visibility
16	Infantry company, night, poor visibility
17	Airbase, daylight, good visibility
18	Airbase, daylight, poor visibility
19	Airbase, night, good visibility
20	Airbase, night, poor visibility

Figure IV-10-A-3. Mission Types and Codes

enemy airspace occurs. A code of 2 indicates that the requirements are applicable only when a penetration occurs. When a 3 is inserted, then the entries of aircraft and fuel are applied to both a penetration and nonpenetration type situation. In the cases where the requirements are different for penetration and nonpenetration situations, two cards must be input for each mission type. If the requirements are the same, one card per mission type will be sufficient.

(e) First DAF Aircraft/Munition Mix (Columns 6-26):

1. Type and Quantity of Aircraft (Columns 6-14):

a. Aircraft Item Code (Columns 6-8). Insert the item code of the aircraft that is first choice to fly all missions of this type. Note that a maximum of nine aircraft types may be played.

b. Minimum Aircraft Requirements (Columns 9-10). Insert the minimum number of aircraft of the type specified in columns 6-8 that would be required to successfully complete the mission type denoted in columns 3-4. This field should be right justified. Blue forces aircraft should be assigned in pairs for the buddy system in which one aircraft watches over the other while first one and then another go in on the target. Thus, the number assigned to any mission would always be an even number. In assigning the number of aircraft for a particular target type, several factors must be borne in mind. If the target is a tank company and the enemy forces always accompany their tank companies with heavy air defense weapons, it may be necessary to have more aircraft airborne for the attack than if these units were lightly defended from attacking aircraft. In any event the number of aircraft specified in these card columns will be the criterion for mission implementation or aborting. If the available aircraft for a new DAF mission assignment are fewer in number than that specified for this type mission and aircraft/munition mix, then the mission cannot be executed; and the requester (INC model) will be asked to seek another means of fire support.

c. Maximum Aircraft to be Committed (Columns 11-12). For close air support aircraft, omit this field. For DAF aircraft, insert the maximum number of aircraft of the type specified that would be required to successfully complete this mission type. The data should be right justified.

d. Minimum Aircraft to Attack This Target (Columns 13-14). Insert the number of aircraft that would be required to successfully engage the target type specified for this mission type. This value should be less than or equal to the value specified in columns 9-10. Since some of the aircraft specified to be the minimum to start the mission may be attrited en route to the target, the minimum value would be larger than this "attack" value. If the aircraft reach the target with less than the attack value, the mission is aborted; and the aircraft return to their base. They may be attrited on their return trip regardless of whether they actually attack the designated target. The data should be right justified.

2. Fuel Required (Columns 15-22). Omit this field for close air support aircraft. Prepare the data as follows for DAF aircraft.

a. Minimum Mission Essential Fuel (Columns 15-18). Insert the minimum fuel (gallons) required per aircraft to complete the mission using the specified aircraft type. The data should be right justified.

b. Maximum Fuel Capacity (Columns 19-22). Insert the fuel capacity (gallons) per aircraft for the specified aircraft. Data should be right justified.

3. Engagement Range (Columns 23-26). Insert the range (meters) from the target at which the aircraft attacking the specified target type would generally stand off to begin their actual air strike on the target. This horizontal range is used in determining how many air defense weapons are firing at the aircraft enroute to the target, attacking the target, and on the return trip to the airbase. There will be a different engagement range for each aircraft/munition mix for each mission type. The data should be right justified.

(f) Second DAF Aircraft/Munition Mix (Columns 27-48). If this mission type is capable of being attacked by more than one DAF aircraft/munition mix, then the second choice DAF aircraft would be specified in these columns. The instructions are identical to those given in paragraphs (e)1 through (e)3. In case the aircraft are not available in sufficient quantities for the first choice, requirements for the second choice will not be met unless the number of aircraft is reduced or the aircraft type is different.

(g) Close Air Support Aircraft/Munition Mix (Columns 49-70). If this mission type is a suitable target for close air support, the choice of aircraft would be specified in these columns. The instructions are identical to those given in Paragraphs (e)1 through (e)3 above except fuel requirements (columns 59-66) and maximum aircraft requirements (columns 55-56) are not needed.

c. Minimum Ammunition and Personnel Requirements (Card Type 2). The minimum aircraft ammunition and personnel requirements for mission performance are input for each mission type in card type 2 (see Figure IV-10-A-4). Information to be inserted in the type 2 card supplements that which was inserted in the type 1 cards. A separate type 2 card must be filled out for each DAF mix within the mission type that was defined in the type 1 cards. This card is omitted for close air support aircraft. Thus, there may be a maximum of 40 type 2 cards. There are six sections to this card type: card type, force designator, mission type, aircraft/munition mix, type and quantity of ammunition, and personnel required.

(1) Card Type (Column 1). This column has the number 2 preprinted.

(2) Force Designator (Column 2). Insert R or B depending on whether data pertain to the Red force or Blue force.

(3) Mission Type (Columns 3-4). Insert the appropriate mission type code from Figure IV-10-A-3. This code will be a right-justified number between 1 and 20.

(4) Mission Type Description (Columns 5-20). Write a description of the mission type whose code was inserted in columns 3-4. These columns are not read by the computer but they do serve to make the data cards self-documenting.

(5) Aircraft/Munition Mix (Column 21). Insert the integer value 1 or 2. If this card refers to the first DAF choice for the mission type, enter a 1. If this card refers to the second DAF choice for the mission type, enter a 2. This card is omitted for the close air support choice.

(6) Ammunition Types Loaded on Aircraft (Columns 22-69):

(a) The Air Ground Engagement model is limited by a maximum of six different aircraft ammunition types. Several different ammunition types may be loaded on each aircraft type, but the total number of ammunition types must not exceed six.

(b) Ammunition Item Code (Columns 22-24). Insert the item code of the first ammunition type to be loaded on the aircraft assigned in the type 1 card for the mix specified in column 21 and the mission type specified in columns 3-4.

(c) Minimum Number Rounds (Columns 25-69). Insert the minimum number of rounds of the ammunition type specified required for the assigned aircraft to successfully complete the mission type requested. Enter the number of rounds that this aircraft must have on board prior to take-off on this mission with this aircraft choice. The number of rounds for this aircraft will be multiplied by all the aircraft that should be in this flight and becomes one of the limiting features for take-off or denial of a DAF mission request. The order in which ammunition type and number of rounds are entered in this segment of the card bears no relationship to the priority in which the pilot will use this ammunition once in the target area. All ammunition must pertain to this aircraft and be the type that would be used against the target named in the mission type. This value must be right justified in column 29.

(d) Additional Ammunition Types (Columns 30-69). Insert the item code and the minimum number of rounds required for any additional ammunition types, up to a maximum of six, which are to be loaded on the assigned aircraft for this aircraft choice and mission type.

(7) Personnel Required (Columns 70-71). Insert the minimum number of personnel required to fly each of the assigned aircraft for this priority and mission type. The pilot, copilot, and all crewmen are considered here.

d. Maximum Ammunition and Personnel Requirements (Card Type 3):

(1) General. The maximum aircraft ammunition and personnel requirements for mission performance are input for each mission type in card type 3 (see Figure IV-10-A-5). A card type 3 is required for every type 2 card that is input. This card is omitted for close air support aircraft mixes. The format of the type 3 card is identical to that of the type 2. The difference is that the type 2 cards specified minimum equipment amounts that must be available in

Figure IV-10-A-5. Maximum Ammunition and Personnel Requirements for Mission Performance

[illegible]

order to initiate a requested mission type, whereas type 3 cards specify the maximum equipment amounts that will be loaded on each mission type. There should be as many type 3 cards as there are type 2 cards.

(2) Card Type (Column 1). The number 3 has been preprinted.

(3) Force Designator (Column 2). Enter R or B depending on whether data pertain to Red force or Blue force.

(4) Mission Type (Columns 3-20). Instructions are the same as for the type 2 card. Refer to paragraphs c(3) and c(4) above.

(5) Aircraft/Munition Mix (Column 21). Insert the integer value 1 or 2. See paragraph c(5) above.

(6) Ammunition Types Loaded on Aircraft (Columns 22-69). The maximum amount of ammunition types specified in the type 2 cards is to be entered in the type 3 cards. If different item codes are input, the card will be rejected by the edit program. The instructions for this card are the same as columns 22-26 on card type 2 (see paragraph c(6) above).

(7) Personnel Required (Columns 70-71). Enter the maximum number of personnel required to fly each of the assigned aircraft for each aircraft choice and mission type.

e. Aircraft Mission Preparation Delay Times (Card Type 4):

(1) General. The aircraft mission preparation delay time for each mission type is specified in the type 4 card (see Figure IV-10-A-6). The mission preparation time is predicated on elapsed time for briefing pilot and crews, coordinating supporting fires, aircraft warm-up time, and time for take-off and make up of any formations. The time entered is that which will elapse between the receipt of the mission request at the airbase until the aircraft can be airborne. Rearming, changing the ammunition load, and other time-consuming chores must also be considered in this elapsed time. Time to prepare for the flight is established based on the number of aircraft that will participate in the flight.

(2) Card Type (Column 1). The number 4 is preprinted. Make no change.

(3) Force Designator (Column 2). Enter R or B depending on the force to which the data pertain.

(4) Mission Type (Columns 3-20). The instructions are the same as in paragraphs c(3) and c(4) above.

(5) Aircraft Item Codes and Preparation Times (Columns 21-65). For each mission type, preparation times are entered for each aircraft type that will fly the mission. These include the aircraft that fly all or any of the three aircraft/munition mixes. The times are partitioned according to the number of aircraft in the formation that will fly the mission type specified in columns 3-4.

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(a) Aircraft Item Code (Columns 21-23). Enter the item code of one of the aircraft that will perform the specified mission type.

(b) Time to Prepare Aircraft for Mission (Columns 24-35). Time in tenths of minutes is to be entered in these card columns. The elapsed time is from moment of receipt of the mission request at the flight area or airbase until the flight is airborne. Three different elapsed times are specified. The first is that for less than five aircraft. The second is for between five and ten aircraft, and the third is for more than ten aircraft.

1. Less than Five Aircraft (Columns 24-27). Enter the elapsed time from receipt of the mission request until it is conceivable to have the requisite aircraft airborne. A decimal point is assumed between columns 26 and 27. If the time for preparation for less than five aircraft was 30 seconds, then the integer 5 would be written in column 27 to represent 0.5 minutes. If the time was 10-1/2 minutes, then the numbers 105 would be written in columns 25 through 27. All numbers are to be right justified.

2. Five to Ten Aircraft (Columns 28-31). The mission preparation time for five to ten aircraft will require a longer period of time than for less than five. The larger the number of aircraft in the flight, the greater is the coordination required between ships. If enroute air defense is particularly well covered, alternate routes to the target may be necessary. All such plans require time; hence, a greater amount of elapsed time for five or more aircraft. Enter the time in tenths of minutes. A decimal is assumed between columns 30 and 31. All figures will be right justified, and leading zeros will not be entered.

3. More than 10 Aircraft (Columns 32-35). Enter the elapsed time in tenths of minutes. A decimal is assumed between columns 34 and 35. Right justify the values.

(c) Time to Prepare Other Aircraft (Columns 36-65). Entries for these card columns will follow the detailed instructions provided in paragraph e(b) above. Column titles and definitions are identical to those in the aforementioned paragraphs. As above, assumed decimals are used when entering the time delays. The assumed decimals are between the following columns: 41 and 42, 45 and 46, 49 and 50, 56 and 57, 60 and 61, 64 and 65.

4. DATA INPUT BY AIRCRAFT TYPE (2602):

a. General. Nine aircraft types can be defined for use in this model. The four card formats included in this section allow characteristics, in addition to those discussed above, to be entered into the model for each aircraft type specified. Aircraft involved in both air-ground and air-mobile roles must have data entered on the first three card types. The fourth card type pertains to air-ground rotary winged aircraft only. The card formats are used to enter aircraft speed, degradation of aircraft for maintenance, aircraft landing time, and elapsed time for returning aircraft to become available for new missions. These card formats are identified by the number 2602 in columns 73 through 76.

b. Aircraft Flight Speed (Card Type 1):

(1) The aircraft flight speed card format is the first of the series of formats that have a dependency on the type of aircraft. The format for

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input of aircraft flight speeds is presented in Figure IV-10-A-7. The speeds are input as a function of weather code, flight area, and aircraft type. The flight areas are coded as shown in Figure IV-10-A-8.

Flight Area Code	Description
1	Flight in friendly territory
2	Flight in enemy airspace, helicopter
4	Flight in enemy airspace, high performance attack aircraft

Figure IV-10-A-8. Flight Area Codes

(2) Card Type (Column 1). The number 1 is preprinted. Make no change.

(3) Force Designator (Column 2). Enter R or B for the appropriate Red or Blue force.

(4) Aircraft Item Code (Columns 3-5). Enter the item code of the first aircraft used in any of the mission types.

(5) Flight Area (Column 6). Insert the number 1 to denote that the speeds presented in columns 7-22 are for the aircraft specified in columns 3-5 when flying over friendly territory. These speeds are input as a function of weather.

(6) Daytime, Good Visibility (Columns 7-10). Enter the average flight speed in knots of the specified aircraft type when flying in friendly airspace under daytime, good visibility conditions.

(7) Daytime, Poor Visibility (Columns 11-14). Enter the average flight speed in knots of the specified aircraft when flying in friendly airspace under daytime, poor visibility conditions.

(8) Nighttime, Good Visibility (Columns 15-18). Enter the average flight speed (knots) when flying in friendly airspace under nighttime, good visibility conditions.

(9) Nighttime, Poor Visibility (Columns 19-22). Enter the average flight speed (knots) when flying in friendly airspace under nighttime, poor visibility conditions.

(10) Flight Area (Column 23). Enter either 2 or 3 to designate the flight area code. A 2 would be entered for the aircraft speed of a helicopter

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when flying a nap-of-the-earth mission in enemy air space. A 3 would be entered for the speed of a high performance aircraft flying at 6000 feet in enemy airspace.

(11) Aircraft in Enemy Airspace (Columns 24-39). Enter the appropriate speed for the specified aircraft when flying in enemy airspace at the altitude specified by the flight area code and under each of the four weather conditions.

(12) Aircraft Name (Columns 57-72). Write in an unclassified name for the specified aircraft. The information entered in these six columns is not used by the Air Ground Engagement Model. It serves as self documentation for the data.

c. Aircraft Landing Time Requirements (Card Type 2):

(1) General. This is the second in the series of card formats dependent on aircraft type. While the most significant variable in this card format is aircraft type, for model purposes the weather descriptor is of considerable importance. The entire data set of this card format is concerned with item codes of aircraft and the weather as they affect the landing time. Landing time is defined as the elapsed period of time from the aircraft entering the landing pattern until it is parked in its revetment or other location on the airbase. The time interval for landing aircraft is split at the less than five aircraft, five to ten aircraft, and more than ten aircraft. The number of aircraft pertain to the flight that is about to land. The format of this card is illustrated in Figure IV-10-A-9, Aircraft Landing Times. There are two principal card segments, one being the card type and force designator, and the second being the aircraft item code with weather descriptor and landing times.

(2) Card Type (Column 1). The number 2 has been preprinted. Make no change.

(3) Force Designator (Column 2). Enter only R for Red or B for Blue force. Any other entry will cause the card to be rejected.

(4) Aircraft Item Code (Column 3-5). Enter the equipment item code assigned to this aircraft. (Army aircraft only.)

(5) Aircraft Landing Time (Column 6-33):

(a) General. For each of the four weather codes the elapsed time in minutes that is required for each aircraft to enter the landing pattern and park in the designated area is entered into the data base. The times that are input are a function of the number of aircraft in a formation; i.e., less than five, five to ten, or more than ten aircraft. Each type aircraft will have four sets of landing times based on the weather code.

(b) Weather Code (Column 6). Each of the four weather descriptors will be entered for each aircraft type. Enter the number (or code) representing the first weather condition (see Figure IV-10-A-1).

(c) Less than Five Aircraft, Minutes (Columns 7-8). Enter the elapsed time in minutes to land this aircraft under weather conditions expressed by the code in column 6. If fractional or decimal minutes are present, round upward and enter as a whole number. All figures are to be right justified.

(d) Five to Ten Aircraft, Minutes (Columns 9-10). Enter the time for a flight of from five to ten aircraft to land and park on designated areas of the airbase.

(e) More than Ten Aircraft, Minutes (Columns 11-12). The time for a flight of more than 10 aircraft to land on one runway with selected prevailing wind direction is to be entered in these card columns. Fractions of minutes or decimal minutes are to be rounded upward. Only whole numbers are to be entered in these card columns, and all are to be right justified.

(f) Landing Times for Other Weather Codes (Columns 13-33). The landing times for the remaining three weather codes are to be completed for the aircraft item code entered in columns 3-5. The instructions for accomplishing these entries are the same as those just described.

(6) Additional Aircraft (Columns 34-64). The detailed entries for the landing times of additional aircraft are to be made in accordance with the above instructions. These landing times are also for varying weather conditions and the three different aircraft formation sizes. Each type aircraft will have four sets of landing times based on the weather descriptor. The card format shown in Figure IV-10-A-9 has sufficient card columns to input data needed for two different aircraft types. With a possible nine aircraft being played in the model, there may be a requirement to complete five cards of data.

d. New Missions for Returning Aircraft (Card Type 3):

(1) General. This card is the third in the series of card formats that are dependent on aircraft types. The turn around time for aircraft returning from one mission and readying for another is to be input through this card format. These aircraft have all been on prior missions and suffered some degree of damage (type kills). The estimated time is for these aircraft to be readied for the next combat missions. Four damage categories are considered in the model. These are: A-kill (catastrophic kill), B-kill (forced landing), C-kill (mission abort), and D-kill (hit, but minor damage).

(a) When an aircraft suffers an A-kill, it crashes because of the damage inflicted and is not recoverable for future use.

(b) Type B-kill forces the aircraft to land (powered or unpowered) because of damage or forces it to make a precautionary landing because of an automatic warning signal indicating trouble. If the downed aircraft has penetrated enemy airspace, it is not recoverable and is considered destroyed. If no penetration of enemy territory occurred, the downed aircraft is recovered after an appropriate delay time. It can then be used in future engagements.

(c) When a type C-kill occurs, the aircraft is forced to discontinue its fire mission because of damage to the aircraft or because of a pilot or copilot casualty. In this case, the aircraft immediately breaks

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off its engagement with the target and returns to its base. Type C-kills are susceptible to additional attrition from air defense weapons on the return trip.

(d) Aircraft suffering type D-kills are considered able to complete their mission. A repair time is imposed on them when they return to their airbase.

(e). Each of the conditional kills listed will delay getting an aircraft back into operational condition suitable for fire mission assignment. Since there is a wide range of circumstances that might delay an aircraft for each category, the figures entered in the card format must be averages of times for various conditions. In addition to the kill condition, the length of time to ready an aircraft for a new flight mission is also required for those undamaged aircraft returning from flights less than 60 minutes and those from flights whose mission lasted more than 60 minutes. In less than 60 minutes, the fuel consumed, ammunition consumed by automatic weapons, briefing of pilots and crews, and the like are assumed to require a correspondingly shorter time than those missions that extended beyond 1 hour. The user is asked to account for these differences as the data are entered in the data base.

(2) Card Format. The card format to be used in completing data for the returning aircraft to operational status is shown in Figure IV-10-A-10, New Mission Availability Time for Returning Aircraft. There are four major segments of this card format. The first is for the card type and force designator. The second segment is item code of aircraft and the minutes required to return the aircraft to operational status under the varying damage conditions. The third and fourth segments are a repeat of the second segment. Detailed instructions will be given for the first set of aircraft item codes and delay times. They also apply to the data for the remaining card columns of this format.

(3) Card Type (Column 1). The number 3 has been preprinted. Make no change.

(4) Force Designator (Column 2). Enter either R for Red or B for Blue forces. No other entry is acceptable; and if any other entry is made, the card will be rejected.

(5) Aircraft Type and Elapsed Time (Columns 3-25). These series of columns consist of the aircraft item code, the turnaround time for an aircraft suffering from a B-kill, C-kill, or D-kill; time to turn around an undamaged aircraft that has returned from a mission of less than 60 minutes duration; and the turnaround time for an undamaged aircraft that has returned from a mission of more than 60 minutes duration. Each of these situations was explained in general terms in the preceding subparagraphs. Enter only whole numbers, rounding off fractions of decimals, all right justified.

(a) Aircraft Item Code (Columns 3-5). Enter the item code of the aircraft that will be played in the model. (Army aircraft only.)

(b) B-Kill Delay (Columns 6-9). Enter the time in minutes that is required to service an aircraft sustaining a B-kill.

Figure IV-10-A-10. New Mission Availability Time for Returning Aircraft

[illegible]

(c) C-Kill Delay (Columns 10-13). Enter the time in minutes that is required to return an aircraft from a mission abort situation to active operational status.

(d) D-Kill Delay (Columns 14-17). Enter the elapsed time in minutes to return an aircraft to full operational status when it has had minor damage.

(e) Mission Less Than 60 Minutes (Columns 18-21). The elapsed time in minutes that is required to ready an undamaged aircraft for full operational status after returning from a mission of less than 60 minutes is to be entered here. The elapsed time begins from parking on runway or strip (immediately after landing time) and terminates upon signaling readiness for the next mission.

(f) Mission More Than 60 Minutes (Columns 22-25). The minutes of elapsed time for readying the undamaged aircraft for a new mission having landed from a mission requiring more than 60 minutes of time is entered here.

(6) Other Aircraft and Ready Times (Columns 26-71). The list of other aircraft item codes is to be entered in the card columns so headed (26-28 and 49-51). For these specific aircraft the ready times for full operational status are to be entered in minutes in the card columns bearing appropriate titles. The instructions for completing the data entry details were explained in the preceding subparagraphs.

(7) Additional Aircraft and Readiness Times (Columns 77-80). The card format illustrated in Figure IV-10-A-10 can record the ready times for three aircraft. A maximum of nine aircraft can be played in this model; and if all are included, then at least three different cards of type 3 format must be prepared, sequentially numbering the cards in these columns.

e. Degradation of Available Aircraft for Maintenance (Card Type 4):

(1) General. For each aircraft type listed in the type 1 card formats, a table of maintenance degradation factors is input. This is the fourth and last in the series of card formats that are dependent on type of aircraft for constant data base information. In this instance the model requires information on how many aircraft of each type will be available for each of the days that the game is played. The answer is expressed as a percentage of total aircraft that are to be available on each day of a total game period. The percentage of total aircraft that are available is a composite figure. First, subtract from the total number the aircraft pulled for maintenance inspection and engine overhaul at the end of a 100-, 200-, or 500-hour period as desired. Then, assuming that some needed parts are not available, a certain percentage of these overhauls is deadlined for lack of parts. The period of time that they are deadlined for lack of parts is up to the judgment of those entering the data in these files. After engine overhaul the aircraft is again placed into service. The individual preparing data is to consider only the aircraft that would be in for normal scheduled maintenance, engine overhaul, replacement of other gear, or scheduled activity of some type that might keep the aircraft out of action.

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(2) Card Description. The format for this card is illustrated in Figure IV-10-A-11, Degradation of Available Aircraft for Maintenance. The data entries consist essentially of the card type and force designator, the item code of this aircraft, followed by a series of percentages for each of the days in the total game period. An explanation will be given for data entries through card column 13, which includes percent available through D-day plus 1. The instructions for data entries in the remaining columns are identical with the instructions for the first 13 and will not be repeated.

(3) Card Type (Column 1). In Figure IV-10-A-11, the number 4 is preprinted in this column. Make no change. This figure relates the balance of the data to this aircraft and the quantity that are to be available for each flight throughout the total game period.

(4) Force Designator (Column 2). Enter R for Red or B for Blue force.

(5) Aircraft Item Code (Columns 3-5). Enter the item code that specifically identifies this aircraft. (Army aircraft only.)

(6) D-day Percentage (Columns 6-9). The percentage of aircraft available for flying missions is to be entered in these card columns. For the first day, it may be assumed that all aircraft are available for all missions. If this is the case then 100 percent of aircraft are for duty, and it would be entered as 1000. That is, four card columns have been reserved for the percentage available. Thus, 1000 is written for 100 percent. If the percentage available drops to 85.5 percent, this would be entered as 855. If the percentage were 70 percent, a trailing zero would be added so that the 70 percent entry would be 700. No decimals are to be entered in the card format. All numbers in the extreme right card column of this data set (in this case it is column 9) are tenths of a percentile. If there is no tenth of a percentile, then a zero is to be entered.

(7) D-day Plus 1 (Columns 10-13). The percentage figure entered here is the net balance of aircraft that may be deadlined for operational parts, those that are sent to shops for overhaul, and those that are returned for normal maintenance or routine and periodic preventive inspections. Over the total game period the percentage available may vary from high to low; that is, on D-day plus 2 the percentage may be 99.5 percent, whereas on D-day plus 6 it could dip to 82.5 percent and rise again on D-day plus 13 to 90.5 percent. In any event the actual number of aircraft that will be ready for mission will be this percentage reduced by those aircraft that have been lost through enemy force action. Those preparing this card format entry are not to consider the losses that might occur in enemy action. This will be accounted for by other subroutines in the model. Only routine type maintenance and inspection procedures that pull aircraft off line and deny them for mission assignments are considered for these entries.

(8) D-day Plus Other Days (Columns 14-61). The percentage of aircraft available for flight and mission type assignment is to be determined as for the entries explained in subparagraph (7) above.

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CARD TYPE 4. DEGRADATION OF AVAILABLE AIRCRAFT FOR MAINTENANCE (Army aircraft only)																							
CARD TYPE	ACFT ITEM CODE	D DAY + 1			D DAY + 2			D DAY + 3			D DAY + 4			D DAY + 5			D DAY + 6			D DAY + 7			CARD NO.
		PCT	AVAIL	AVAIL	PCT	AVAIL	AVAIL	PCT	AVAIL	AVAIL	PCT	AVAIL	AVAIL	PCT	AVAIL	AVAIL	PCT	AVAIL	AVAIL	PCT	AVAIL	AVAIL	
1	0 1																						1
2	0 1																						2
3	0 1																						3
4	0 1																						4
5	0 1																						5
6	0 1																						6
7	0 1																						7
8	0 1																						8
9	0 1																						9
10	0 1																						10
11	0 1																						11
12	0 1																						12
13	0 1																						13
14	0 1																						14
15	0 1																						15
16	0 1																						16
17	0 1																						17
18	0 1																						18
19	0 1																						19
20	0 1																						20
21	0 1																						21
22	0 1																						22
23	0 1																						23
24	0 1																						24
25	0 1																						25
26	0 1																						26
27	0 1																						27
28	0 1																						28
29	0 1																						29
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38	0 1																						38
39	0 1																						39
40	0 1																						40
41	0 1																						41
42	0 1																						42
43	0 1																						43
44	0 1																						44
45	0 1																						45
46	0 1																						46
47	0 1																						47
48	0 1																						48
49	0 1																						49
50	0 1																						50

Figure IV-10-A-11. Degradation of Available Aircraft for Maintenance

(9) Additional Aircraft. There will be one card type 4 prepared for each type aircraft that is to participate in the total game period. Up to nine aircraft can be played on each side; therefore, up to nine cards may be used.

5. DATA INPUT BY WEAPON TYPE (2603).

a. General. The data requirements to be described in these card formats are dependent primarily on weapon type. The card formats built around the air defense weapon type can be identified by the number 2603 in columns 73 through 76. Four card formats are included in the weapon type category. They are air defense weapon characteristics, degradation of air defense, terrain and vegetation effects, and aircraft average vulnerable area.

b. Characteristics of Air Defense Weapons (Card Type 1):

(1) General. This is the first card format which has the air defense weapon as the principal dependency. A possible maximum of nine different types of air defense weapons may be used in the model. In stating the characteristic of air defense weapons, the model wants to know for each type of air defense weapon, and under each of the four weather descriptors, the number of rounds usually fired during an engagement, the maximum effectiveness of the weapon, and similar topics. The card format is illustrated in Figure IV-10-A-12. There are five segments: card type and force designator, weapon type item code, weapon employment distance, munition item code, and weapon characteristics under each of the four weather codes.

(2) Card Type (Column 1). The number 1 has been preprinted. Make no change.

(3) Force Designator (Column 2). Enter either R for Red force or B for Blue force.

(4) Item Code (Columns 3-5). Insert the weapon item code for the weapon type to which the data in this card pertain.

(5) Employment Distance (Columns 6-10). Enter the distance (meters) the weapon type specified in columns 3-5 is generally employed behind the FEBA. This distance is used in the calculation of the point in friendly airspace to which the attacking aircraft may fly and not be in range of any enemy air defense weapons.

(6) Weather Code (Columns 11-28 and 29-46). The characteristics of the specified weapon type are input in these columns for each of the four weather codes. Two sets can be put on this card, and the remaining two weather descriptors and associated weapon characteristics must be input on a second card of this type. Thus, for each air defense weapon type, there will be two cards.

Figure IV-10-A-12. Air Defense Weapon Characteristics

[illegible]

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(a) Weather Code (Column 11). Consult Figure IV-10-A-1 for the codes used in the different weather descriptors. The code entered here applies to the balance of the card column data entered in the remaining columns of this segment of the card.

(b) Rounds Per Engagement (Columns 12-15). Not used.

(c) Maximum Effective Range (Columns 16-20). Enter the maximum effective range for this particular weapon in meters. Round fractions to whole numbers.

(d) Average Slant Range (Columns 21-24). Not used.

(e) Accuracy (Columns 25-28). Not used.

(f) Additional Weather Factors (Columns 29-46). Entries will be made in these card columns for a change in weather condition but for the same weapon type. Enter values for the characteristics just discussed in the preceding subparagraphs for the second weather code. Use the same definition of terms and identical column headings. In this manner the balance of the card will be completed with appropriate data.

(7) Munition Item Code (Columns 47-49). Enter the equipment item code of the ammunition that will be fired by the weapon type whose equipment item code is given in columns 3-5.

(8) Weapon Name (Columns 47-72). Enter an unclassified name for this weapon type. The computer will not read this information. It serves to assist the user.

c. Reduced Effectiveness of Air Defense Weapons (Card Type 2):

(1) General. Not used.

(2) Card Type (Column 1). The number 2 has been preprinted. Make no change.

d. Terrain and Vegetation in Air Defense (Card Type 3): Not used.

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e. Aircraft Average Vulnerability Area (Card Type 4):

(1) General. The vulnerable area (hundredths of square meters) that will down an aircraft if it is hit by an air defense weapon is the dimension that is input in this card format. The air defense weapon is the primary dependency, with aircraft type and vulnerable area also needed.* Types of aircraft kills were listed in paragraph 4d(1). These same definitions of kills are used in this card format and for these vulnerability areas.

(2) Card Format. The card format is illustrated in Figure IV-10-A-17, Aircraft Average Vulnerability Area. The square meters of A-kill, B-kill, C-kill, and D-kill are the required entries. These are all related to a type of aircraft and the air defense weapon that is to attack that aircraft. Essentially there are four major segments of the card format. The first is the card type and force designator, with the second being item code of the weapon, followed by the aircraft item code and its vulnerability areas.

(3) Card Type (Column 1). The number 4 is preprinted in this card. Make no change.

(4) Force Designator (Column 2). Only R for Red force or B for Blue force is to be entered in this column. Any other type entry or failure to make an entry will cause the card and data to be rejected from the data base.

(5) Weapon Item Code (Columns 3-5). Enter the item code of this air defense weapon. (Guns only.)

(6) Aircraft Item Code and Vulnerability (Columns 6-28). The aircraft and its vulnerable areas are to be entered in these card columns. The values for the various vulnerable areas will be used to compute the probability of kill and determine the type of such kill. Numbers entered in these columns are to be right justified. The description of each kill type was described in paragraph 4d(1).

(a) Aircraft Item Code (Columns 6-8). The aircraft code assigned for these series of card formats must agree with those that were selected initially for aircraft dependent variable cards such as format type 1 with identified 2601 as explained in paragraph 3 of this appendix.

* The data for these entries will most likely be provided by the Vulnerability Laboratory of the Ballistic Research Laboratories at Aberdeen Proving Ground, Maryland.

CARD TYPE 4. AIRCRAFT AVERAGE VULNERABLE AREA AGAINST SPECIFIC WEAPON TYPES FOR VARIOUS KILL CATEGORIES (Guns only)													
CARD TYPE	RED OR BLUE	WPN TYPE	AIRCRAFT ITEM CODE	KILL CATEGORY				KILL CATEGORY				CARD ID	CARD SEQ. NR.
				TYPE A	TYPE B	TYPE C	TYPE D	TYPE A	TYPE B	TYPE C	TYPE D		
1		0 0 1 1 1	0 1 1 1 1										
2													
3													
4													
5													
6													
7													
8													
9													
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95													
96													
97													
98													
99													
100													

Figure IV-10-A-17. Aircraft Average Vulnerable Area Against Specific Weapon Types for Various Kill Categories

(b) Vulnerable Area, A-kill (Columns 9-13). For catastrophic kills on this type of aircraft enter the vulnerable area (square meters) to the specified weapon type. A decimal point is assumed between columns 11 and 12. If the vulnerable area were 3.01 square meters, the numbers 301 would be entered in columns 11 through 13.

(c) Vulnerable Area, B-kill (Columns 14-18). For forced landings type of hit, enter the vulnerable area of an aircraft of this type to the specified weapon type. A decimal point is assumed between columns 16 and 17.

(d) Vulnerable Area, C-kill (Columns 19-23). For a mission abort enter the vulnerable area for an aircraft of this type to the specified weapon type. A decimal point is assumed between columns 21 and 22.

(e) Vulnerable Area, D-kill (Columns 24-28). For minor damage to the aircraft enter the vulnerable area for an aircraft of this type to the specified air defense weapon. A decimal point is assumed between columns 26 and 27.

(7) Second Aircraft and Its Vulnerability Areas (Columns 29-51). The vulnerable areas for a second aircraft can be entered in this card format. The instructions for completing the data entries for these values are identical with those described in the preceding subparagraphs. The column titles are identical, and the definition of terms are the same. The instructions will not be repeated. Decimal points are assumed between the following columns: 34 and 35, 39 and 40, 44 and 45, and finally 49 and 50.

(8) Additional Aircraft and Their Vulnerabilities. If all nine aircraft types are used in the model, then for each type of air defense weapon, there would be five cards. Since a maximum of nine air defense weapons can be played on each side in the model, a maximum of 45 cards might be required for entry of these data into data file 26 for each side.

6. RESULTS FOR VARIOUS AIR STRIKE SITUATIONS (2701):

a. This card format, identified by 2701 in columns 73-76 is the last format required for the Air Ground Engagement Model's constant data base. The data are loaded on data file 27 and are used in the routine that simulates the actual air strike of the ground target.

b. The data input is used to determine outcomes of engagements between aerial attackers and ground targets in terms of aircraft losses, munition expenditures, and losses inflicted on the ground target. The complete engagement results are extracted from the data input. The data must be prepared pregame from results obtained from high resolution simulation models for engagements under similar conditions.

c. Input to the engagement results tables consists of 456 situations. These situations include five target types under each of the four visibility conditions of daytime, good visibility; daytime, poor visibility; nighttime, good visibility; and nighttime, poor visibility. Targets include a tank company, a mechanized infantry (motorized rifle) company, an infantry company, an artillery battery, and an airbase. These five target types and four

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visibility conditions define 20 mission types shown in Figure IV-10-A-3. For each mission type these situations consist of one of three attack aircraft/munition mixes and one of two placements of air defense weapons (normal and increased) in the target area. Five postures are possible for each mission type against the tank company, the mechanized infantry company, and the infantry company targets (assembly area, attack, defend, on road, and delay). These three target types account for 360 of the 456 situations (12 mission types, 2 air defense placements, 3 aircraft/munition mixes, and 5 postures). For the artillery battery target only three postures are used. These postures are on the road, firing guns, and firing missiles for a total of 72 situations (4 mission types, 2 air defense placements, 3 aircraft/munition mixes, and 3 postures). For the airbase as a target, posture is not considered; hence, this case adds 24 situations (4 mission types, 3 aircraft/munition mixes, and 2 air defense placements). The contents of the engagement results table are shown in Figure IV-10-A-18. Losses to attacking aircraft, defending air defense weapons, and the target itself are all contained in the 54 information items. Use of the Air Ground Engagement Model and analysis of the results must be based on a thorough understanding of each situation that is input into these tables.

d. There are six major segments to this card format: card type and force designator, mission type code, aircraft/munition mix code, target activity code, air defense density code, and the loss or expenditure segments. The card format is shown in Figure IV-10-A-19.

- (1) Card Type (Column 1). The number 1 is preprinted. Make no change.
- (2) Force Designator (Column 2). Enter R for Red force or B for Blue force depending on who is the attacker.
- (3) Mission Type (Columns 3-4). There are 20 possible mission types, dependent on the type target being attacked, whether the attack occurs during daytime or nighttime, and whether visibility is good or poor. From Figure IV-10-A-3 select the mission code that best describes the situation simulated in the high resolution model from which the input data are being prepared. Insert this code in columns 3-4.
- (4) Aircraft/Munition Mix (Column 5). This column is used to designate aircraft/munition mix. Insert the integer 1, 2, or 3 (see paragraph c(5) above). Where applicable, data for all three mixes should be included in the data set.
- (5) Activity Code and Posture (Columns 6-7). The value in this field is dependent on target type. Activity codes as a function of target type are presented in Figure IV-10-A-20. Insert the appropriate activity code in these columns.
- (6) Air Defense Code (Column 8). This column is used to indicate the density of air defense weapons in the immediate vicinity of the target. Two densities may be used. They are normal and increased. If the density of

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Field	Description	Field	Description
1	<u>A-kills</u>	29	<u>Tanks killed</u> by guided missile
2			
3			
4		30	<u>APCs killed</u> by guided missile
		31	by other
5	<u>B-kills</u>		
6			
7		32	<u>Vehicles killed</u> by guided missile
8		33	by other
9	<u>C-kills</u>	34	<u>Personnel killed</u>
10			
11			<u>Air defense weapons killed</u>
12		35	type 1
		36	type 2
		37	type 3
		38	type 4
		39	type 5
13	<u>D-kills</u>	40	type 6
14		41	type 7
15		42	type 8
16		43	type 9
	<u>Aerial munition expended</u>		<u>Air defense munition expended</u>
17	type 1	44	
18	type 2	45	
19	type 3	46	
20	type 4	47	
21	type 5	48	
22	type 6	49	
		50	
	<u>Aerial munition lost</u>	51	
23		52	
24			
25		53	<u>Number of aircraft</u> flying mission
26			
27			
28		54	<u>Duration of engagement</u> minutes x 10 ²

Figure IV-10-A-18. Engagement Results Table

Target Type	Activity or Posture	
	Code	Description
1. Tank company	10	Assembly area
	20	On road
	40	Attack
	41	Defend
	42	Delay
2. Mechanized infantry (motorized rifle) company	10	Assembly area
	20	On road
	40	Attack
	41	Defend
	42	Delay
3. Infantry company	10	Assembly area
	20	On road
	40	Attack
	41	Defend
	42	Delay
4. Artillery battery	20	On road
	30	Firing guns
	31	Firing missiles
5. Airbase	na	Activity not considered

Figure IV-10-A-20. Activity Types and Codes Versus Target Type

air defense weapons in the immediate vicinity of the target is considered normal, enter the number 1. If, however, the density is increased from normal, enter the number 2.

(7) Engagement Results (Columns 9-68). For any particular situation only a small fraction of the 54 information items will be input. In most situations losses for all items will not have occurred. To reduce the number of cards required to indicate the results of an engagement, field numbers have been assigned. Only those fields with nonzero information need be input.

(a) Field Code (Columns 9-10). Enter the field number (see Figure IV-10-A-18) for the first item that suffered losses, kills, or expenditures. This first field may be field 10; i.e., C-kills by 23mm. If no aircraft damage resulted from the engagement, the first field may be field 22, aerial munition type 6 expended.

(b) Number Killed, Lost, or Expended (Columns 11-18). Insert the amount of this item killed, lost, or expended for the field specified in columns 9-10. The data must be right justified. No decimal point is assumed. Hence, if a loss were 10.02 then the number 1002 would be entered in columns 14 through 18.

(c) Additional Items (Columns 19-68). Insert the field numbers and amounts for other items in these columns. Both fields 53 and 54 must be input for every situation. Field 53 contains the number of aircraft actually involved in the attack of the target. Field 54 must contain the duration in hundredths of minutes of the engagement.

e. As an example of how the cards should be filled out, consider the situation of a Red tank company target attacked during daylight hours under clear visibility conditions by two Cobra mounted with TOWs. There is an increased density of air defense weapons in the vicinity of the target. The target is in an assembly area and, consequently, stationary. All damage to the attacking aircraft results from the Red 23mm weapons. Aircraft damage included 0.17847 A-kills, 0.0181 B-kills, and 0.0559 C-kills. The Cobra fired 6.5 TOW to inflict 2.95 tank kills, 0.45 APC kills, and 14.1 personnel kills. The engagement lasted 3 minutes. The required data cards are shown in Figure IV-10-A-21. The attackers were Blue; hence, a B was entered in column 2. From Figure IV-10-A-3 the mission type code for tank company, daylight, good visibility is 1. The number 1 was, therefore, inserted right justified in columns 3 and 4. An aircraft/munition code of 1 is assumed; hence, a 1 is inserted in column 5. The activity code is found in Figure IV-10-A-20 to be 10, assembly area for tank company target. Since an increased density of air defense weapons is in the immediate vicinity of the target, column 8 contains a 2. Columns 9-68 contain the items that were lost, killed, or expended. When input is prepared for a situation, each of the 54 fields in Figure IV-10-A-18 should be examined. In the example all damage to aircraft was inflicted by 23mm air defense weapons; hence, for the first 16 field entries, data are only input for fields 2, 6, and 10. Since all damage to the tank target was inflicted by TOWs, of fields 17 through 22 data are only entered for field 22. Damage to the target is reflected by entries in fields 29, 30, and 34, which are tanks killed, APCs killed, and personnel killed. As required, fields 53 and 54 are also input. Two cards were required to describe this particular situation. The cards are number sequenced in column 80.

7. AIR GROUND ENGAGEMENT CONSTANT DATA DECK STRUCTURE. This paragraph provides information on the data deck structure for constant data input used in the Air Ground Engagement constant data files. The cards making up these decks, the order in which they must be read into the DIVWAG System, and the printouts generated are discussed.

a. Air Ground Engagement Constant Data Input Cards. The different card formats used to enter constant data inputs for the Air Ground Engagement Model are listed in Figure IV-10-A-22. The card type numbers are punched in column 1 of each card. The next column is for B for Blue force and R for Red force. The card titles appear next in the figures, followed by the card identifiers that are punched in card columns 73-76. At the far left is the name of the program that loads the data into the Air Ground Engagement constant data file 26. The last two entries in this figure are for data file 27. These data are the result of air strikes, either Red on Blue or Blue on Red installations.

b. Creating Constant Data Files for Air Ground Engagement Model. The Air Ground Engagement constant data input files are created by reading in the data decks structured as illustrated in Figure IV-10-A-23. At the right of the figure are pictured the subdecks, which are combinations of Red aircraft and Blue air defense weapons and Blue aircraft with Red air defense weapons. The card groupings for these subdecks are illustrated to the left of the figure. These card groupings have friendly forces aircraft and hostile forces air defense weapons. If the friendly forces are Red then the card groupings would have Red aircraft data and Blue air defense data. If the friendly forces were Blue then the air defense weapon data would be Red's. The card groupings are as indicated in the following subparagraphs.

(1) Card Groupings. The card groupings are illustrated to the left of Figure IV-10-A-24 in which the first card is ID 2601, with type 1 having data on aircraft mission requirements. This card may be produced in multiple copies, and the last copy is followed immediately by the first card in the type 2 series of ID 2601. After the last of the type 2 and ID 2601 cards are assembled, they are followed immediately by card type 3 with ID 2601 having data on maximum ammunition and personnel requirements. The sequence of card groupings continues as shown in the left of the figure and as explained for types 1, 2, and 3 in the ID 2601 series.

(2) Assembly of Subdecks. After the card groupings are aligned as shown in the figure they are assembled into the subdecks; that is, data for Blue forces in the 2601 and 2602 card ID series are separated from the same type cards having Red forces data. Immediately behind the Blue forces last card, which is type 4 of ID 2603, the Red forces data beginning with card type 1 and ID 2603 are inserted. In the 2603 series, card types 1 through 4 in Red forces data are placed in this subdeck. This would then constitute the first of two subdecks. These subdecks are illustrated on the right side of Figure IV-10-A-23. The same method would be used to assemble the subdeck for Red aircraft and Blue weapon systems. With the two subdecks assembled they would be combined and submitted for read in by the computer system for the DIVWAG Air Ground Engagement Model constant data input.

Card Type	Force	Card Title	Card ID	Load Program Name
1	B	Minimum/Maximum Aircraft Mission Requirements	2601	AIRLD
2	B	Minimum Ammunition and Personnel Required per Aircraft for Mission	2601	AIRLD
3	B	Maximum Ammunition and Personnel Required per Aircraft for Mission	2601	AIRLD
4	B	Aircraft Mission Preparation Delay Time	2601	AIRLD
1	B	Aircraft Flight Speeds-Knots	2602	AIRLD
2	B	Aircraft Landing Time Required-Minutes	2602	AIRLD
3	B	Aircraft New Mission Availability Time-Minutes	2602	AIRLD
4	B	Aircraft Degradation for Maintenance	2602	AIRLD
1	R	Air Defense Weapon Characteristics	2603	AIRLD
2	R	Air Defense Weapon Reduced Effects Data	2603	AIRLD
3	R	Air Defense Weapon Degradation, Terrain and Vegetation	2603	AIRLD
4	R	Aircraft Vulnerability Areas by Weapon Type	2603	AIRLD
1	R	Minimum/Maximum Aircraft Mission Reqmts	2601	AIRLD
2	R	Minimum Ammunition and Personnel Required per Aircraft for Mission	2601	AIRLD
3	R	Maximum Ammunition and Personnel Required per Aircraft for Mission	2601	AIRLD
4	R	Aircraft Mission Preparation Delay Time	2601	AIRLD
1	R	Aircraft Flight Speeds-Knots per Hour	2602	AIRLD
2	R	Aircraft Landing Time Required-Minutes	2602	AIRLD
3	R	Aircraft New Mission Availability Time-Minutes	2602	AIRLD
4	R	Aircraft Degradation for Maintenance	2602	AIRLD
1	B	Air Defense Weapon Characteristics	2603	AIRLD
2	B	Air Defense Weapon Reduced Effects Data	2603	AIRLD
3	B	Air Defense Weapon Degradation, Terrain and Vegetation	2603	AIRLD
4	B	Aircraft Vulnerability Areas by Weapon Type	2603	AIRLD
1	B	Engagement Results of Air Strikes Red on Blue	2701	AIRLD
1	R	Engagement Results of Air Strikes Blue on Red	2701	AIRLD

Figure IV-10-A-22. Air Ground Engagement Card Format Listings

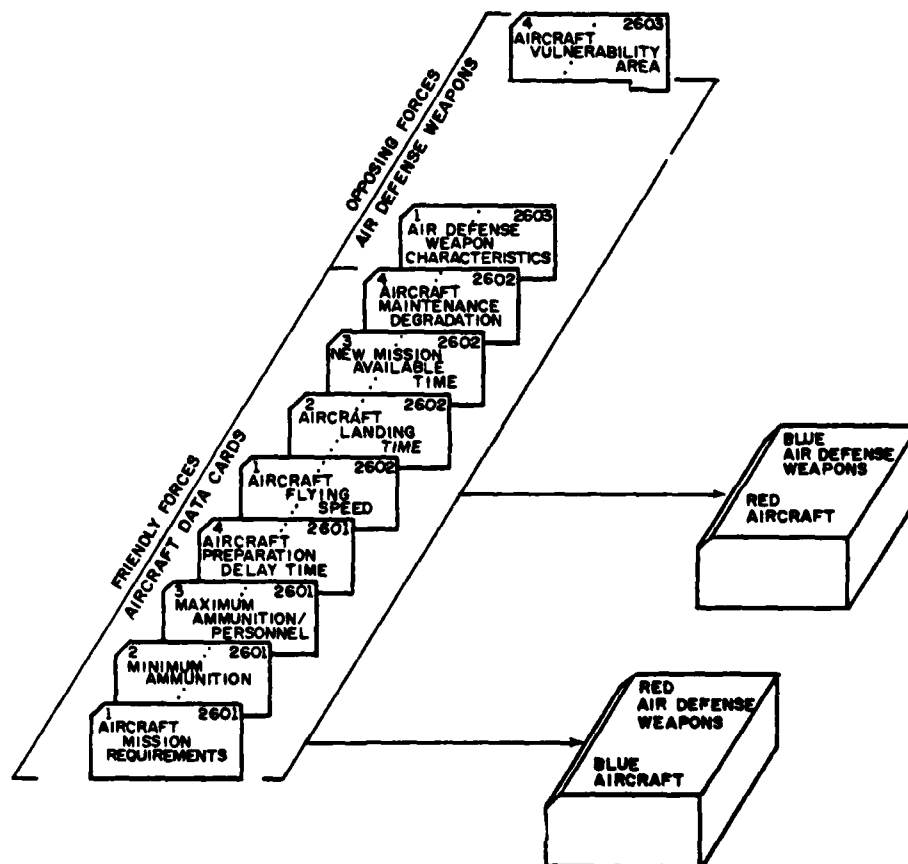


Figure IV-10-A-23. Air Ground Engagement Data Deck Structure

c. Updating Air Ground Engagement Constant Data Files. Changes to the data deck read into the constant data files for Air Ground Engagement can be readily accomplished through the use of the retained data deck. The updating may consist of corrections of errors in data elements, the deletion of information, or the addition of new data. The procedures outlined below govern these processes.

(1) Correcting an Error. Correcting an error or changing a data element is the equivalent of updating Air Ground Engagement constant data files. The card with the error or data to be changed is located, and a new card produced with the correct or changed data punched in. The old card is then removed from the deck, and the newly produced card is inserted in its location. The entire data deck for both the Red and Blue forces is now submitted for another read by the computer. The recreation of the constant data files through reading in the deck with the changed data on cards will constitute the correction of an error or change of a data element.

(2) Deletion of Information. The deletion process may consist of wiping out the entire disk storage or deleting one element or record. The process consists of utilizing the retained data deck in its entirety where elements are to be wiped out. To delete a data element, select the card or cards that have the unwanted data in the files. These cards are removed from the data deck. The purged deck is then submitted for reread to the computer system. The omission of those cards and the recreation of the data files for constant data input for the Air Ground Engagement Model will cause that data to be erased from the files.

(3) Addition of Data. Data may be added at any time prior to the start of the game. This procedure also uses the retained complete data deck. First, the data to be added are prepared in punch card form; and when the cards are produced, they are integrated into the data decks. This integration process is the placing of these new cards immediately behind the card type and format of the ID number of that data to be added. When each set of the newly produced cards has been added behind the existing cards of that type and ID then the deck should be reassembled. The reassembled deck is then ready for submission to the computer system for reread into the data base. Each time that data are entered in the constant data files for Air Ground Engagement a printout report series is generated. This series of printouts displays the information that was last entered through the medium of the structured data deck.

APPENDIX B

AIR GROUND ENGAGEMENT MODEL PROGRAM DESCRIPTIONS

1. INTRODUCTION:

a. Overview of the Air Ground Overlay. The Air Ground Engagement Model overlay contains a set of interdependent and self-sustaining routines. Each of the major routines simulates a specific mission segment. Once the Air Ground Engagement Model is initiated by an air mission request, each of the major routines will be activated in a chronological sequence, through timed events. At the time a mission segment is scheduled to end, the results of that segment are calculated, appropriate unit status file records are updated, and the time at which the next mission segment is to be completed is scheduled. This process links the mission segments, or the submodel routines, in such manner as to simulate the air mission activities.

b. Overlay Structure. The Air Ground Engagement Model overlay (overlay 4 of the DIVWAG Period Processor) contains a main area and four segments. The overlay control routine, AIRGND, and several utility routines are contained in the main area. Segment 1 contains the segment controlling routine ATB, which performs mission setup operations for the model, and supporting routines. Segment 2 contains the routine for calculating aircraft attrition en route to or from the target, ENRATA. Segment 3 is controlled by the routine TORA, which calculates effects of a target strike and contains several supporting routines. Segment 4 contains the routines BTA and SEG5 which accomplish the major routines of each segment, followed by those supporting routines unique to the Air Ground Engagement Model, are documented in this appendix. The other routines in the overlay are general utility routines.

2. ROUTINE AIRGND:

a. Purpose. This program serves as the Air Ground Engagement Model driver. AIRGND conducts a call sequence to the Air Ground routines in one of two orders depending on whether the air mission will penetrate the forward edge of the battle area (FEBA). If the mission is not required to penetrate enemy airspace, AIRGND will bypass the in-flight attrition (ENRATA) routine; otherwise, ENRATA will be called at the appropriate time.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
INCOPR	TWO	A sequential index used to monitor which programs have been called and which are to follow.
PENFLG	TWO	Penetration flag; 0 = no 1 = yes

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c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
INCOPR	TWO	Same as input description.

d. Logical Flow (Figure IV-10-B-1):

(1) Blocks 1 and 2. The value of INCOPR is saved in JNCOPR, and INCOPR is incremented.

(2) Block 3. If PENFLG equals 1, indicating a penetration of enemy airspace, control branches to block L100.

(3) Blocks 4 through 9. If JNCOPR is 1, 2, 3, 4, or 5 a call is generated to routines ATB, BTF, DRPEXC, BTF, or SEG5 respectively. Upon return from these routines, control is returned to the calling routine. If JNCOPR is not within the correct range, control transfers to block 16.

(4) Blocks L100 through 15. PENFLG is equal to 1. If JNCOPR is 1, 2, 3, 4, 5, 6, or 7, a call is generated to ATB, BTF, ENRATA, DRPEXC, ENRATA, BTF, or SEG5 respectively. Upon return, control returns to the calling routine. If JNCOPR is not within this range, control goes to block 16.

(5) Blocks 16 through L140. If PENFLG equals 1 and JNCOPR is within the range 8 to 11, or if PENFLG is not equal to 1 and JNCOPR is within the range 6 to 9, call BTA: otherwise, print an error message. Return control to calling routine.

3. ROUTINE BTF:

a. Purpose. This routine updates the coordinates of the mission unit as it arrives at the safe point near the FEBA. The fuel consumption rate is calculated and the fuel used in flying from the airbase to the safe point is subtracted from the mission unit's fuel load. A call to CCOLLM at this point in the flight keys sensing trials (within the Intelligence and Control Model) by air defense radars.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
UMAIN(500)	DF1	Unit status record of the air mission unit.
UNTLOC(2,1000)	TWO	X and Y coordinates of units.
IUIDAB	TWO	Identification of the airbase unit.
IUIDMU	TWO	Identification of the air mission unit.

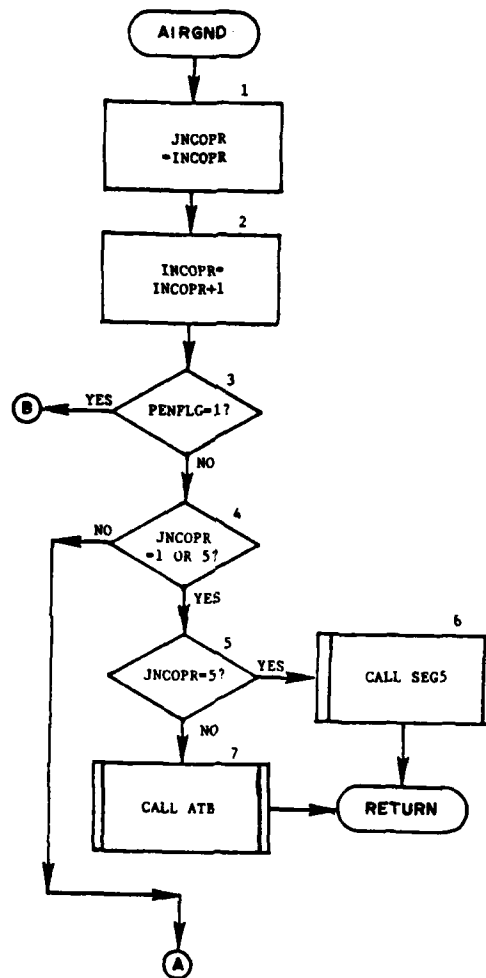


Figure IV-10-B-1. Routine AIRGND (Continued on Next Page)

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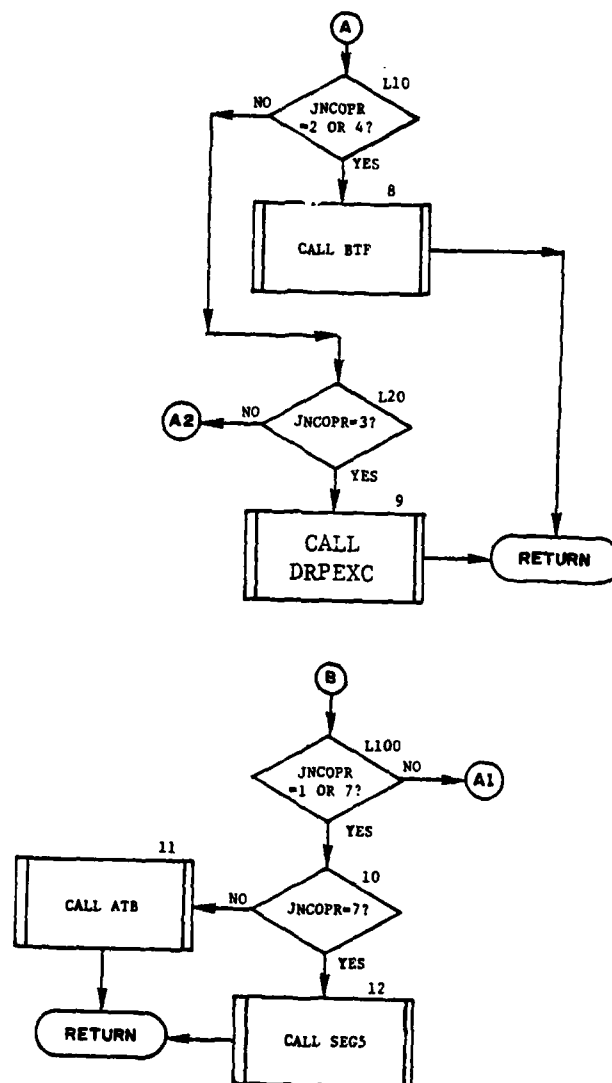


Figure IV-10-B-1. Routine AIRGND (Continued)

IV-10-B-4

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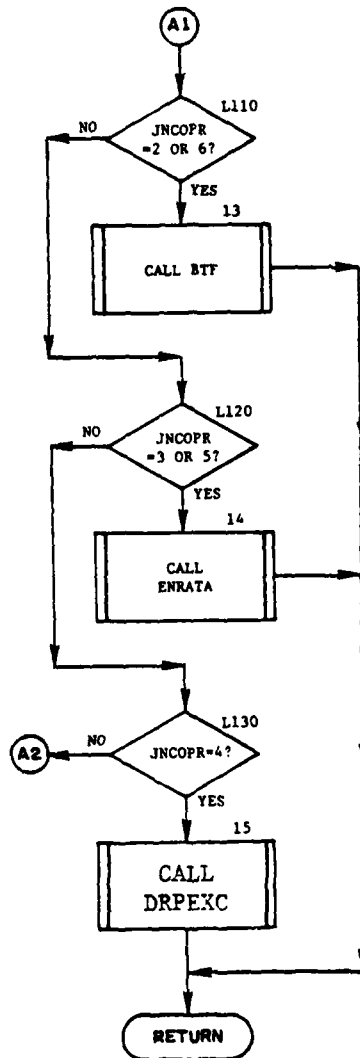


Figure IV-10-B-1. Routine AIRGND (Continued)

IV-10-B-5

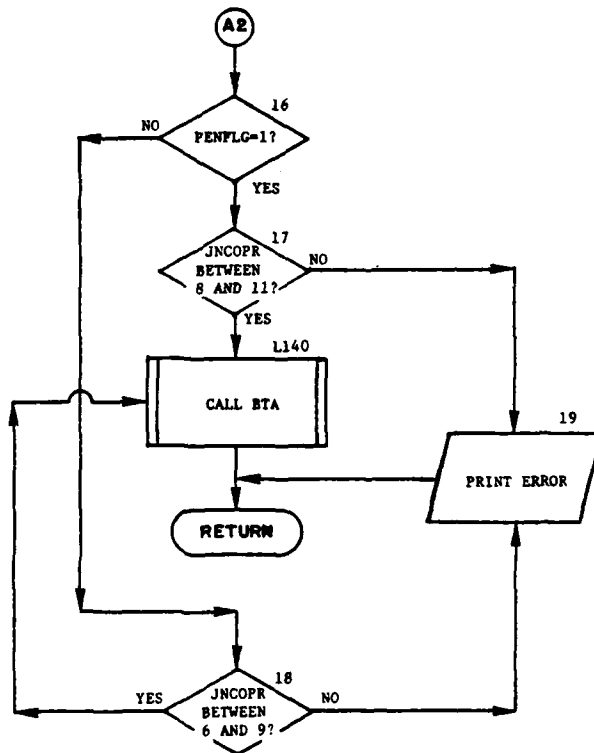


Figure IV-10-B-1. Routine AIRGND (Concluded)

IV-10-B-6

<u>Name</u>	<u>Source</u>	<u>Contents</u>
INCOPR	TWO	A code used to branch to various routines within the Air Ground Engagement Model.
AXFEBA	TWO	X coordinate of the safe point.
AYFEBA	TWO	Y coordinate of the safe point.
ACAVL	DF26	Item codes of aircraft and aircraft munitions.
CONSMP(20)	DF14	Fuel consumption rates for aircraft.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
UMAIN(500)	DF1	Unit status record of the air mission unit.

d. Logical Flow (Figure IV-10-B-2):

(1) Block 1. The air mission unit's status record is obtained from data file 1.

(2) Block 2. Routine CCOLLN is called to allow enemy sensors to detect the mission unit's flight from the airbase to the FEBA and to create sensing reports.

(3) Block 3. The coordinates of the mission unit are updated to its current location near the FEBA.

(4) Block 4. The objective coordinates of the mission unit are updated to those of the target area.

(5) Block 5. The fuel consumption rate is determined for this type of aircraft. The rate is a function of aircraft speed and altitude and is stored on data file 14.

(6) Block 6. The consumption rate is stored on the mission unit's status record.

(7) Block 7. The fuel consumed in flight between the airbase and the FEBA is calculated and subtracted from the fuel load on the mission unit.

(8) Block L200. The next air mission event is scheduled.

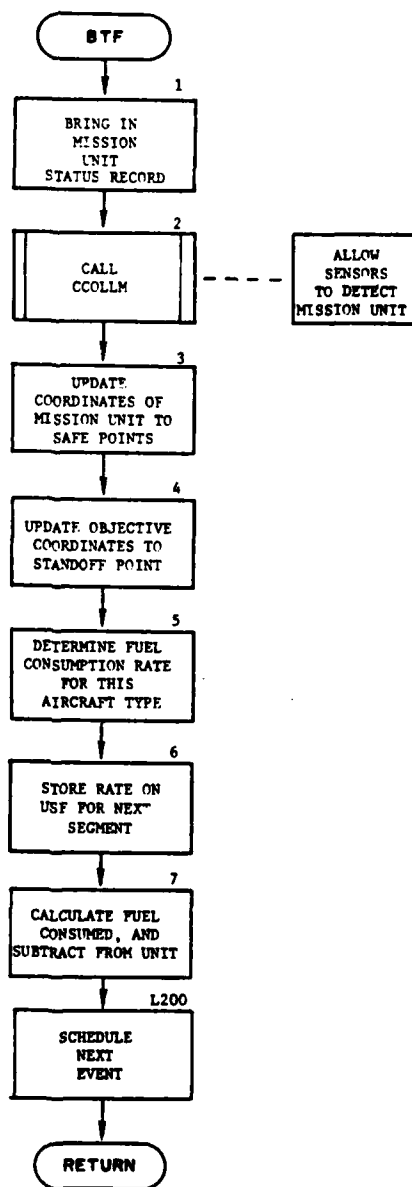


Figure IV-10-B-2. Routine BTF

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4. ROUTINE ATB:

a. Purpose. The routine's primary function is to act as a mission scheduler and a resource allocation model at the time of a mission request for attack or mine delivery aircraft. The airbase that will support the air mission will be selected, if it has not been specified by DSL. For attack aircraft the type of mission to be flown is determined from available information about the target, including target type, size, activity, coordinates, and prevailing weather conditions. Based on the type of air mission selected, minimum aircraft resources needed to attack the target will be allocated. These resources include aircraft type and number, munition types and quantities, number of required personnel, and fuel. The quantities of resources may be increased from the minimum amounts required to predetermined maximum amounts, if additional resources are available at the airbase. For mine delivery air missions, resource requirements are determined through DSL and mission mix tables. Each mix table will contain aircraft type, required amounts of personnel and fuel, up to three types and quantities of mines to be delivered, mine dispensing rate, and the strip width per aircraft. The routine then creates an air unit to carry out the mission request. The air unit is loaded with its allocated resources, and a future event for the air mission is scheduled.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
LUIP	TWO	Identification of the unit requesting air support.
IUIDTG	TWO	Identification of the target unit.
ESTX	TWO	Estimated X coordinate of the target.
ESTY	TWO	Estimated Y coordinate of the target.
MISFLG	TWO	Flag that indicates type of air support, TACAIR or attack helicopter.
PENFLG	TWO	Flag that indicates if mission requires penetration of the FEBA.
UTDTAB(1000)	TWO	Unit type identifications.
UNTLOC(2,1000)	TWO	Unit coordinates.

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SORTY(72)	DF26	Available TACAIR sorties.
ACAVL(72)	DF26	Item codes of aircraft, munitions, and air defense weapons and ammunition.
MTDATA(36)	DF26	Minimum resources needed for mission completion.
DACMAX(36)	DF26	Maximum resources needed for mission completion.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
IUIDMU	DF12	Identification of the mission unit.
MT	DF12	Type of mission being carried out.
TTIME	DF12	Time aircraft must be at the safe point.
AXFEBA	DF12	X coordinate of the safe point.
AYFEBA	DF12	Y coordinate of the safe point.
DISTAB	DF12	Distance from the safe point to the target engagement point.
IUIDAB	DF12	Identification of the airbase where the mission originates.
TIMF	DF12	Time to fly from the airbase to the safe point.
TIMT	DF12	Time to fly from the safe point to the target engagement point.
SORTY(72)	DF26	Updated number of available TACAIR sorties.
REJFLG	DF12	Type of reject, should a mission be aborted.

d. Logical Flow (Figure IV-10-B-3):

(1) Blocks 1 and L110. If the air mission was requested by the Intelligence and Control Model, all airbases, either Army or Air

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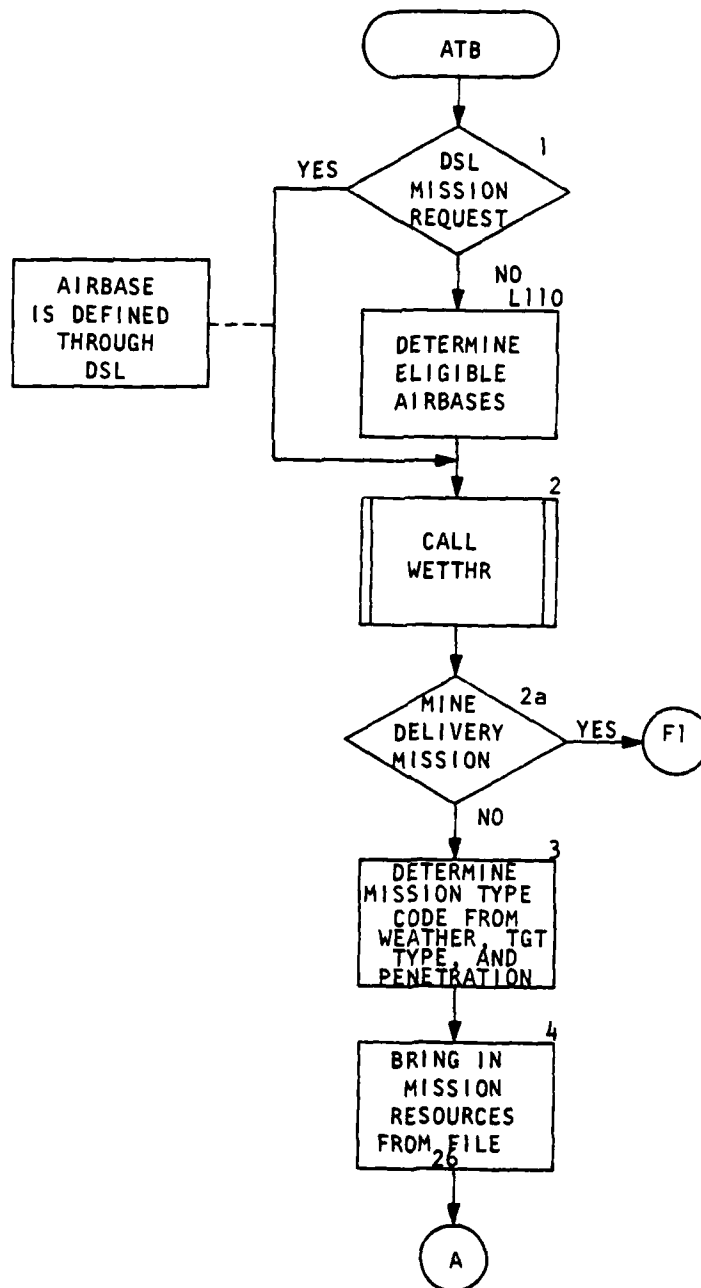


Figure IV-10-B-3. Routine ATB (Continued on Next Page)

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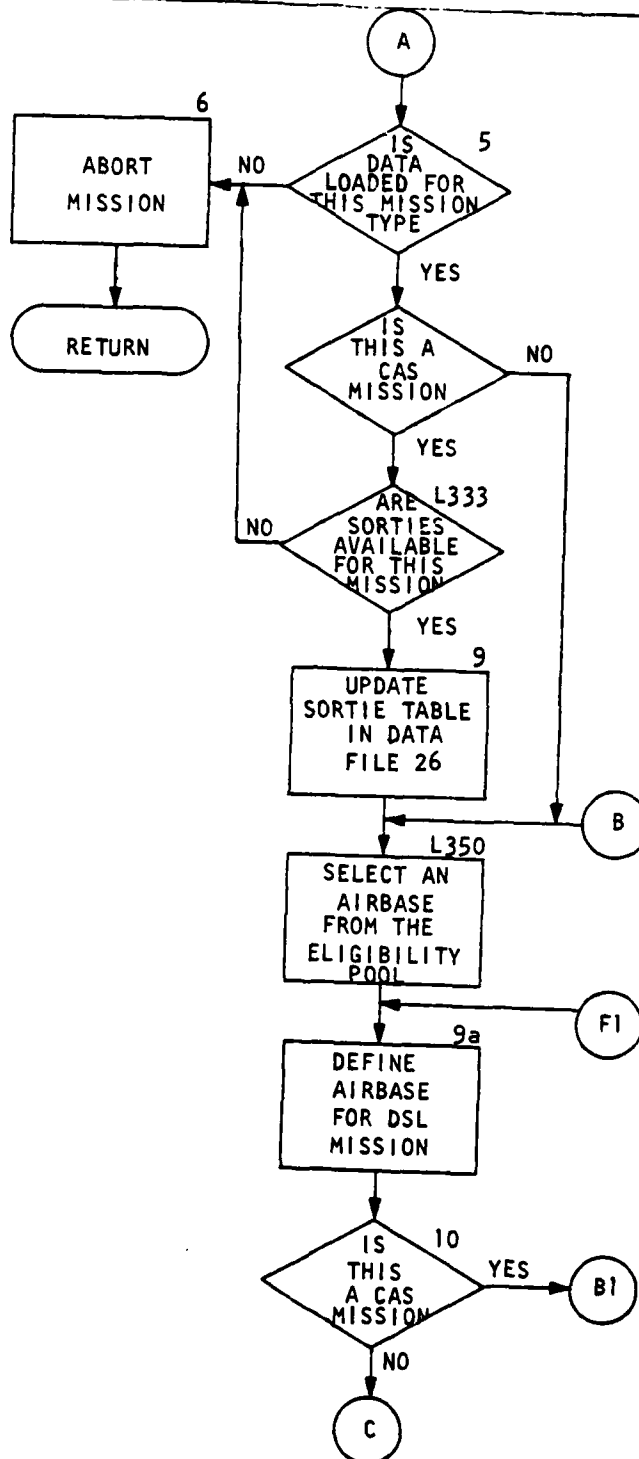


Figure IV-10-B-3. Routine ATB (Continued)

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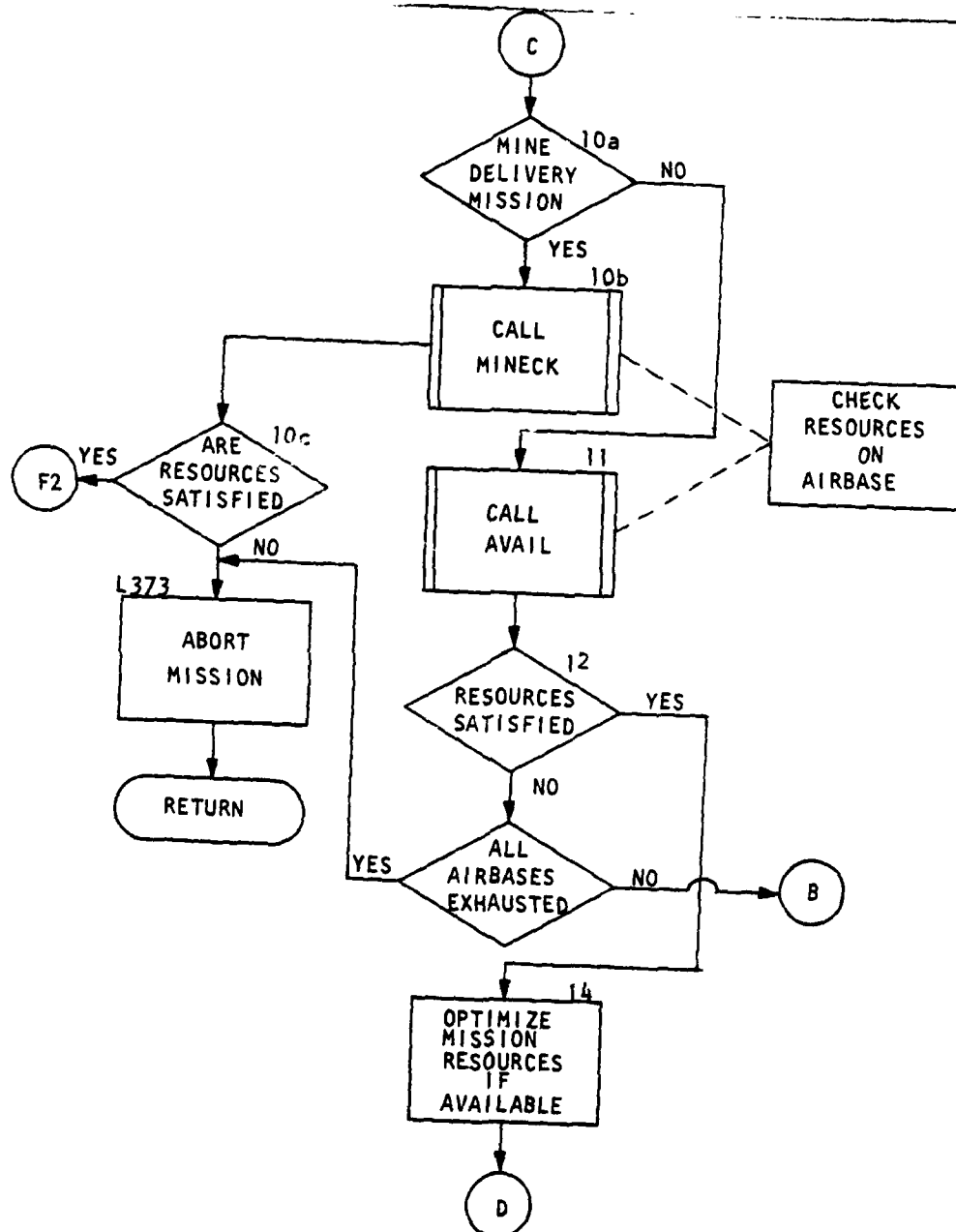


Figure IV-10-B-3. Routine ATB (Continued)

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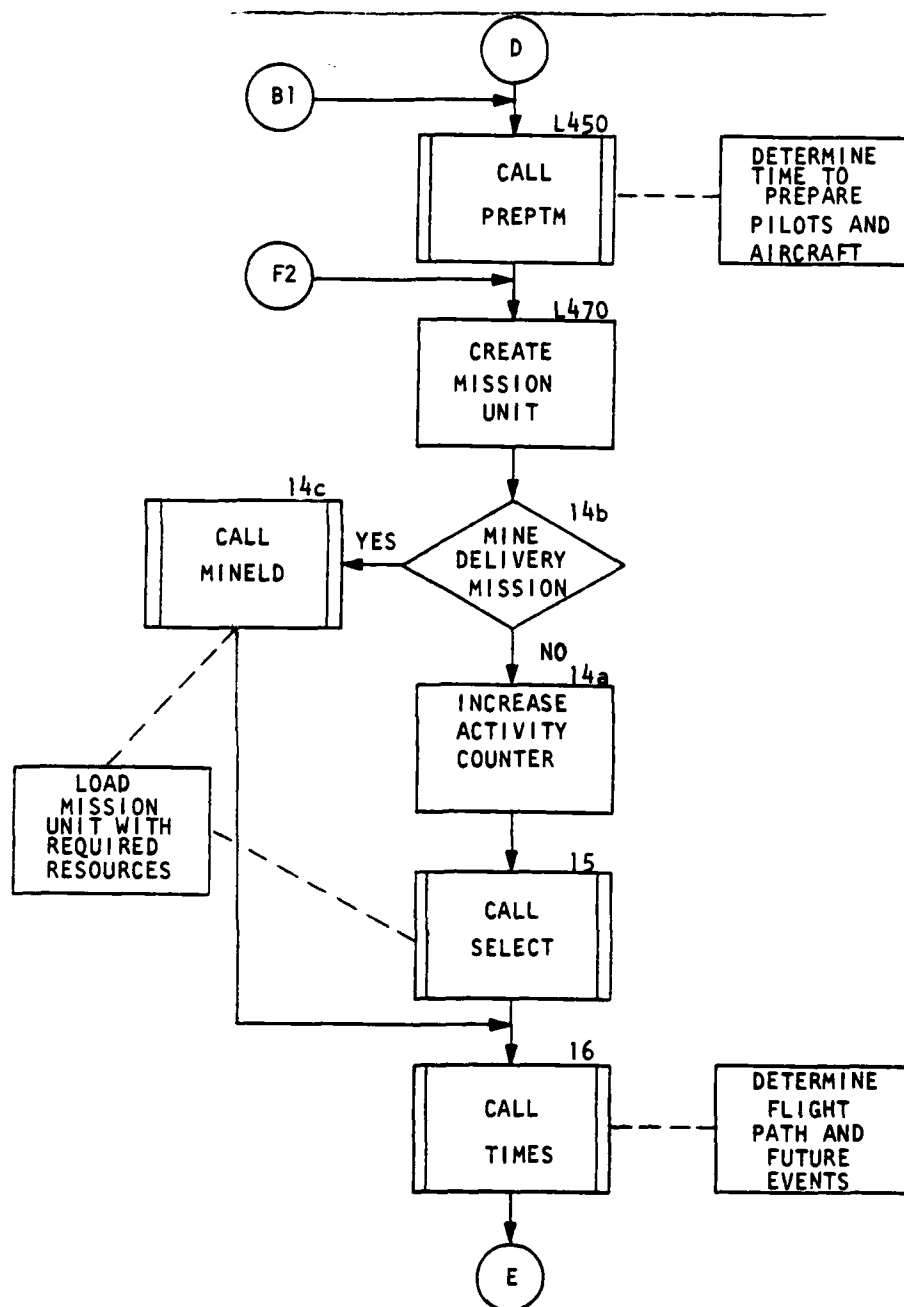


Figure IV-10-B-3. Routine ATB (Continued)

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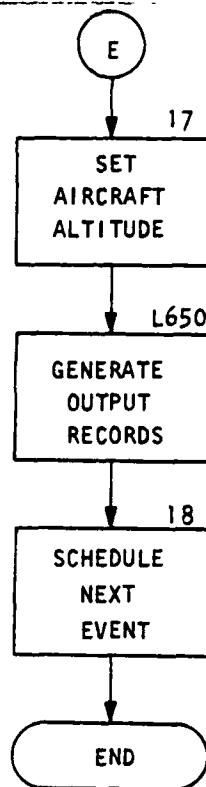


Figure IV-10-B-3. Routine ATB (Concluded)

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Force depending on the mission request, are determined. The airbases are ranked according to nearness to the target in the following order:

- . Airbases in direct support to the unit requesting the mission.
- . General support airbases.
- . Airbases in direct support to a unit other than the requesting unit.

From this list an originating airbase will be selected for the mission. If the mission is DSL requested the airbase is prespecified and the list of airbases contains the single unit.

(2) Block 2. Routine WETTHR returns one of the following weather codes:

- . 0 - day, good visibility
- . 1 - day, poor visibility
- . 2 - night, good visibility
- . 3 - night, poor visibility

(3) Block 2a. Is this mission a delivery of scatterable mines?

(4) Block 3. The type mission index is determined based on target type, prevailing weather condition, and if the attacking aircraft will be required to penetrate enemy air space to reach the target area.

(5) Block 4. Using the mission type index, data are accessed from data file 26 describing the resources required for this mission type.

(6) Blocks 5 and 6. A check is made to determine if resource data are complete for this mission type. If not, the mission is aborted and control returns to the calling routine.

(7) Block 7. A check is made to determine if this mission type requires attack helicopters or high performance aircraft (CAS), and control goes to block L333 or block L350 respectively.

(8) Block 9a. For DSL mission requests, the supporting airbase is specified in the DSL.

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(9) Blocks L333, 8, and 9. A check is made to determine if enough sorties are available to carry out the requested mission. If not, the mission is aborted and control returns to the calling routine. If so, subtract the number of sorties being allocated to the mission request from the availability pool stored on data file 26.

(10) Blocks L350 and 10. An airbase is selected from the ranked list. If this is a CAS mission, for which there are no resource limits other than sorties, control branches to block L450; otherwise to block 11.

(11) Block 10a. Is this mission a delivery of scatterable mines?

(12) Block 10b. Routine MINECK checks the availability of requested resources on the airbase.

(13) Block 10c. Are the resources available on the airbase?

(14) Block 11. Routine AVAIL compares the resources on the airbase with those needed by the air mission.

(15) Block 12. If the airbase resources satisfied the minimum mission requirements, control goes to block 14; otherwise, to block 13.

(16) Blocks 13 and L373. If all airbases on the ranked list have been exhausted trying to satisfy minimum mission requirements, the air mission is aborted. If not, control returns to block L350 to select another airbase.

(17) Block 14. If airbase resources are great enough. the air mission resources are increased up to the maximum amounts defined in block 4.

(18) Block L450. Routine PREPTM establishes the time necessary to brief pilots and prepare aircraft for the mission.

(19) Block L470. An air mission unit is created on data file 1.

(20) Block 14a. The activity counter is incremented by the number of aircraft on the mission unit.

(21) Block 14b. Is this mission a delivery of scatterable mines?

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(22) Block 14c. Routine MINELD loads the mission unit with the requested resources.

(23) Block 15. Routine SELECT loads the air mission unit with the required resources.

(24) Block 16. Routine TIMES determines the flight path of the air mission unit and future event times.

(25) Block 17. The altitude of the air mission unit is set.

(26) Block L650. An analysis output record is generated consisting of pertinent information about the scheduling of this mission and its resource allocations.

(27) Block 18. A time event is scheduled to arrive at the FEBA based on current time, preparation time, and aircraft speed.

5. ROUTINE AVAIL:

a. Purpose. This routine checks the availability of the minimum resources needed to satisfy the mission request. In addition, the routine utilizes a function to degrade the number of available aircraft on the base to allow for those which may be incapacitated due to preventive maintenance. If the mission request did not originate from DSL, the number of available aircraft is further reduced by those aircraft being held in reserve for only DSL mission requests.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
UMAIN	DF1	Airbase unit status record.
IUIDAB	TWO	Identification of the airbase.
ACAVL(72)	DF26	Item codes for aircraft and munitions.
HARD(36)	DF26	Aircraft degradations due to preventive maintenance.
IDSL	TWO	A flag indicating if mission was a DSL request.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
IAVIAL	Call	A flag indicating if the airbase satisfied all resource requirements.

(d) Logical Flow (Figure IV-10-B-4):

(1) Block 1. The availability flag is initialized to zero, meaning requested mission resources are available at the airbase.

(2) Block 2. The type and number of aircraft requested for this mission type are determined from the ACAVL data array.

(3) Blocks 3 and 4. The data table is obtained to degrade total aircraft on the airbase due to preventive maintenance.

(4) Blocks 5, L100, and L275. If the number of aircraft and the munition types and quantities requested for this mission is available on the airbase, control returns to the calling routine. If not, the availability flag is set to one and control returns to the calling routine.

6. ROUTINE PREPTM:

a. Purpose. This routine returns a mission initiation delay time nominally due to pilot briefings and aircraft preparations. The delay time is a function of aircraft type and quantity.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
PREPT(36)	DF26	Aircraft/pilot preparation times.
MTSAVE(10)	TWO	Aircraft type and quantity.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
PTIME	Call	Preparation delay time.

d. Logical Flow (Figure IV-10-B-5):

(1) Block 1. The type of aircraft requested for this mission type is determined.

(2) Block 2. The number of aircraft requested for this mission type is determined.

(3) Block 3. Preparation delay times are obtained from data file 26.

(4) Block L20. The appropriate delay time relative to aircraft type and quantity is selected and control returns to the calling routine.

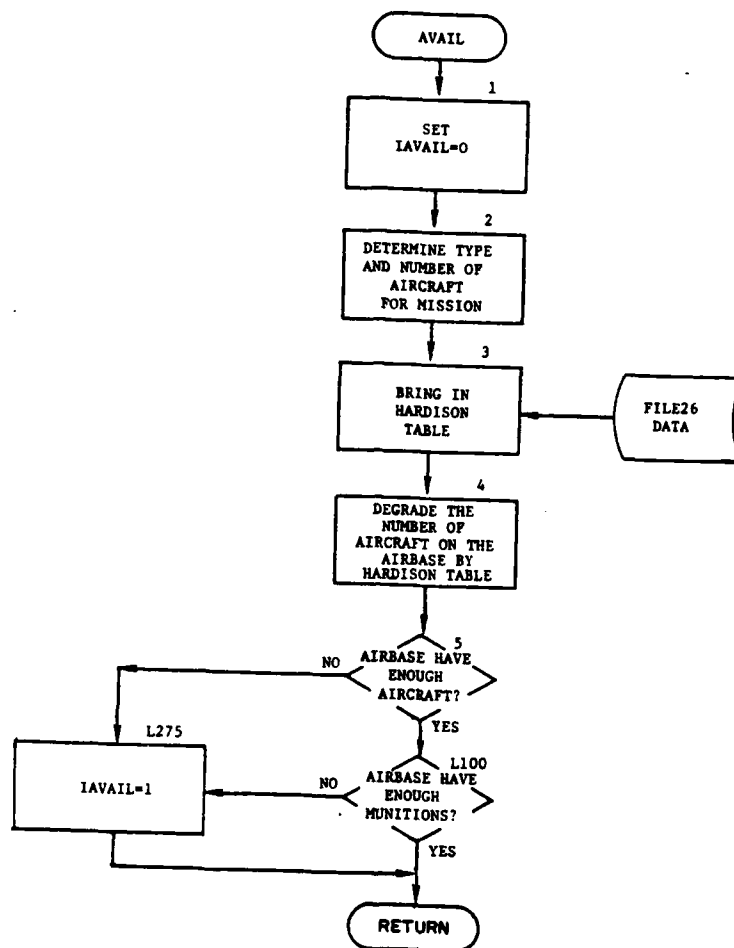


Figure IV-10-B-4. Routine AVAIL

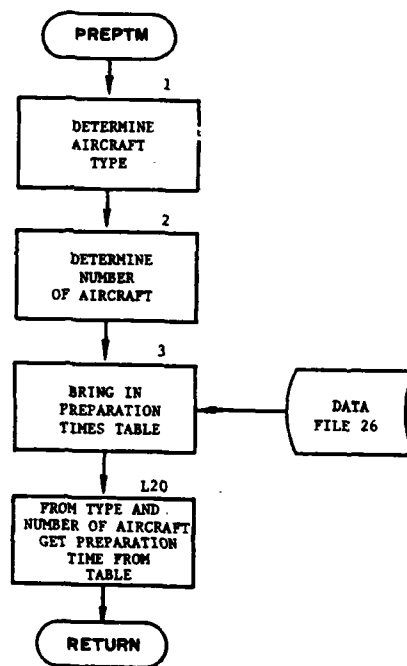


Figure IV-10-B-5. Routine PREPTM

7. ROUTINE TIMES:

a. Purpose. This routine determines the various segments of the air mission flight path and the time elapsed during each segment. The first step in producing the flight path is the determination of a safe point from enemy air defense weapon fire near the FEBA. The safe point lies in a plane perpendicular to the FEBA through the target. This point establishes the end of the first segment, the airbase being the start of the segment. This may be the only segment of the flight path, if penetration of the FEBA is not required to allow the mission unit's munitions to reach the target; however, if penetration is required, the next segment will begin with the safe point and end at the target. Penetration of the FEBA is predetermined by either the Intelligence and Control Model or routine ARCNRL before the Air Ground Engagement Model receives the mission request; however, if after determining the safe point, it is found that the mission unit does not have the capability to reach the target area due to munition range constraints, the mission unit will be allowed to penetrate the FEBA to a point where the target is within range. Penetrating beyond the FEBA, however, does make the mission unit vulnerable to enemy air defense fire. The start time of the flight path segment is calculated as a function of segment distance, aircraft speed, and mission start time. The segment start time is used to schedule events for those Air Ground Engagement routines that handle a specific segment of the flight path.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IUIDTG	TWO	Identification of the target unit.
ESTX	TWO	X coordinate of the target unit.
ESTY	TWO	Y coordinate of the target unit.
PENFLG	TWO	A flag indicating if the mission unit requires penetration of the FEBA.
FTLNBN(12)	DF16	Identifies front-line battalion units.
UNTLOC(2,1000)	TWO	X and Y coordinates of units.
SLOPE	ONE	Slope of the FEBA.
WCHAR(36)	DF26	Air defense weapon characteristics.
FLTSPD(36)	DF26	Aircraft flight speeds.
AHENG(36)	DF26	Target engagement stand-off distance.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
TTIME	DF12	Time aircraft must be at the safe point.
AXFEBA	DF12	X coordinate of the safe point.
AYFEBA	DF12	Y coordinate of the safe point.
DISTAB	DF12	Distance between the safe point and the target engagement point.
TIMF	DF12	The flight time between the airbase and the safe point.
XDIST	DF12	Distance the safe point is from the FEBA.

d. Logical Flow (Figure IV-10-B-6):

(1) Block 1. Search the ACAVL table on data file 26 for the air defense weapon with the greatest maximum effective range.

(2) Block 2. Determine the distance the selected air defense weapon is employed behind the FEBA.

(3) Block 3. Compute a distance from the FEBA at which aircraft will be invulnerable to enemy air defense weapon fire.

(4) Block L350. Locate the enemy battalion nearest to the FEBA.

(5) Block 4. Add one half of the nearest enemy battalion's depth to the predetermined safe distance described in block 3.

(6) Block 5. Calculate a safe point on a plane perpendicular to the FEBA through the target. This point, the predetermined safe distance from the enemy battalion, will be positioned toward the friendly side.

(7) Block L500. Compute the distance from the safe point to the target.

(8) Block 6. Compute the distance from the airbase to the safe point.

(9) Block 7. Determine the speed of the aircraft as a function of its type and prevailing weather conditions. Aircraft flight speed data are stored on data file 26.

(10) Block 8. Compute the flight time from the airbase to the safe point. This time is used to schedule an event to arrive at the safe point.

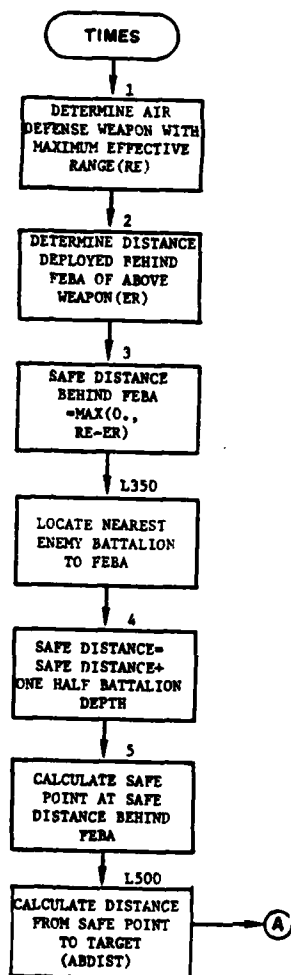


Figure IV-10-B-6. Routine TIMES (Continued on Next Page)

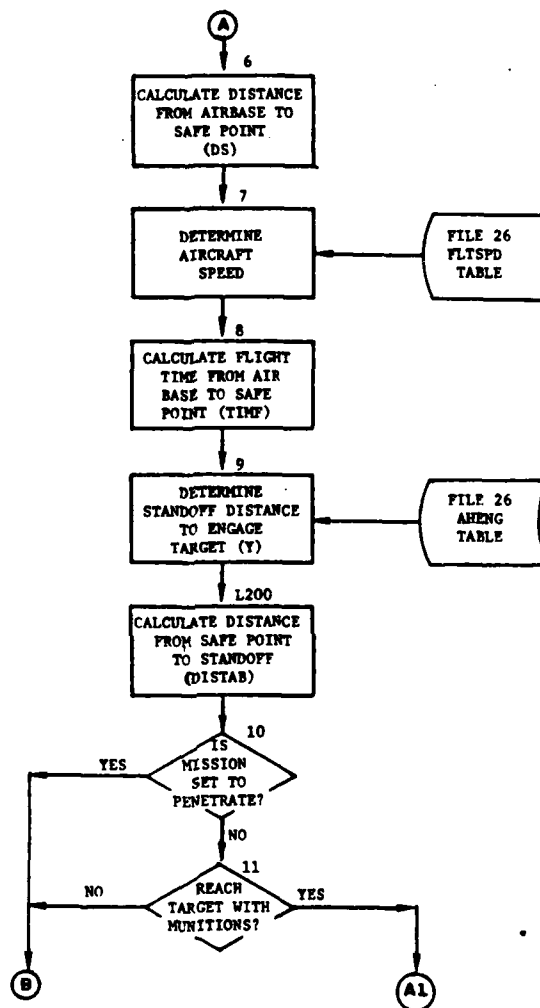


Figure IV-10-B-6. Routine TIMES (Continued)

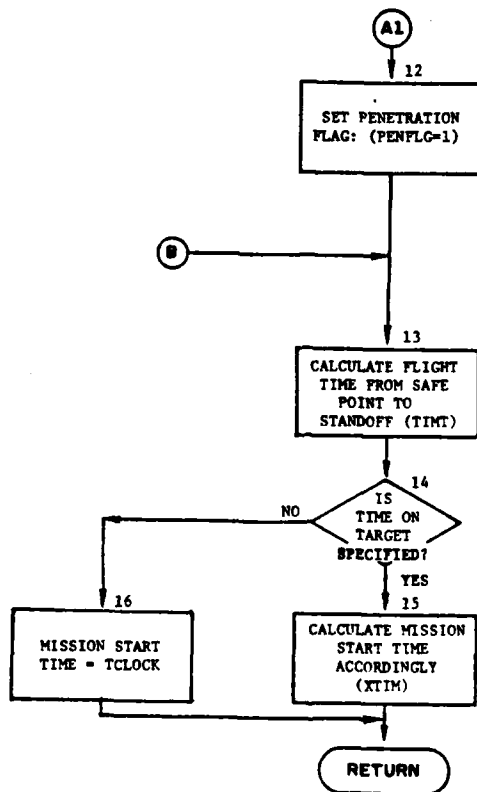


Figure IV-10-B-6. Routine TIMES (Concluded)

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(11) Block 9. Determine the stand-off distance used by the aircraft to engage the target. The stand-off distance is a function of the aircraft/ munition mix and is pregame input data stored on data file 26.

(12) Block L200. Compute the distance from the safe point to the stand-off area.

(13) Block 10. If this mission was originally set to penetrate the FEBA in order to attack the target, control goes to block 13.

(14) Block 11. Does the mission need to penetrate the FEBA to reach the target? If the mission was scheduled for nonpenetration, but the point of standoff lies on the enemy side of the FEBA, the mission is scheduled to penetrate the distance required to reach the stand-off point. If, however, the mission was scheduled for penetration but does not require it to reach the stand-off point, the penetration (or inflight attrition submodel) is not executed. If penetration is not required, control goes to block 13; otherwise, to block 12.

(15) Block 12. If penetration of the FEBA is required to reach the target, set the penetration flag equal to one.

(16) Block 13. Compute the flight time from the safe point to the stand-off point. This time is used to schedule an event to arrive at the target area.

(17) Blocks 14, 15, and 16. A desired time is specified for the attack on the target; compute the mission start time accordingly (i.e., decrement the desired attack time by the time necessary to prepare aircraft and pilots and flight times for the various flight segments. If flight and preparation times refrain the mission unit from reaching the stand-off point at the desired time, no attack time is specified, the mission starts immediately.

8. ROUTINE SELECT:

a. Purpose. This routine transfers requested mission resources from the airbase to the air mission unit. SELECT is not activated until the airbase has been determined, the resources on the airbase were found to be adequate, and the air mission unit is constructed. If the mission request came from DSL, the reserved aircraft pool for DSL requests is reduced by the number of aircraft being transferred to the mission unit.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
UMAIN	ONE	The airbase unit status record.
UCOOP	ONE	The air mission unit status record.

<u>Name</u>	<u>Source</u>	<u>Contents</u>
ACAVL(72)	DF26	Item codes for aircraft and munitions.
IDSL	TWO	A flag indicating if mission was a DSL request.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
UMAIN	ONE	The airbase unit status record.
UCOOP	ONE	The air mission unit status record.
UNTLOC(2,1000)	TWO	The coordinates of the units.

d. Logical Flow (Figure IV-10-B-7):

(1) Blocks 1 and 2. Initialize the newly created mission unit's coordinates to those of the airbase and allocate the required personnel to the mission unit.

(2) Blocks 3 and 4. Check if this mission type requests attach helicopters or high performance aircraft. For an attack helicopter mission subtract personnel allocated to the mission unit from airbase personnel.

(3) Blocks 5, 6, and 7. Allocate the required type and number of aircraft to the mission unit and, if an attack helicopter mission, subtract aircraft allocated to the mission unit from the airbase available aircraft.

(4) Blocks L80 and 8. If this mission was requested from DSL, subtract the number and type of aircraft allocated to the mission unit from the DSL reservation pool.

(5) Block L90. If this is a CAS mission, control returns to the calling routine.

(6) Blocks 9, 10, and 11. Allocate the required munitions and fuel to the mission unit. Subtract the amount of munitions and fuel allocated to the mission unit from the airbase amount. Control returns to the calling routine.

9. ROUTINE MINECK:

a. Purpose. Routine MINECK checks the availability of requested resources for a scatterable mine air-delivery mission. Resources for scatterable mine missions are loaded in a mix table prior to game start. Resources include aircraft type, quantity of fuel and personnel per aircraft, up to 3 types and quantities of mines, aircraft dispensing rate, and the aircraft strip width. For rotary-wing aircraft, if either crew or fuel on the airbase is less than required, the number

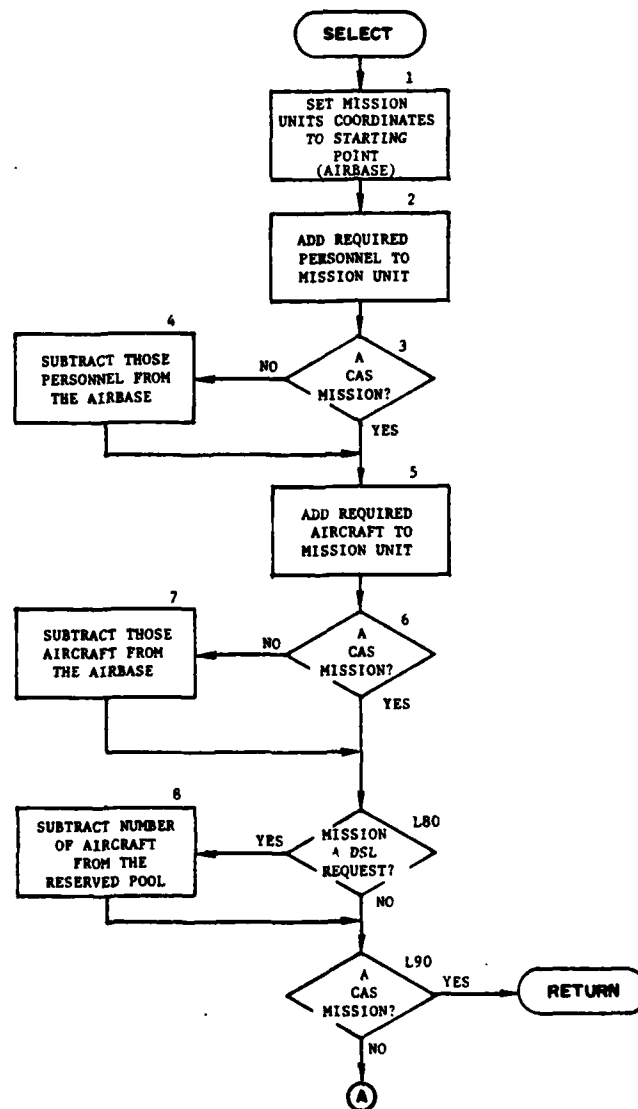


Figure IV-10-B-7. Routine SELECT (Continued on Next Page)

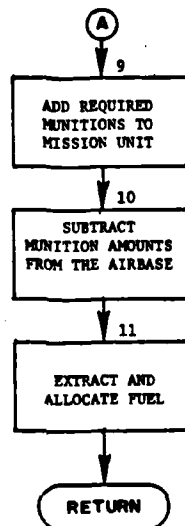


Figure IV-10-B-7. Routine SELECT (Concluded)

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of aircraft will proportionally be reduced for this mission request. The mission will be aborted if there is not at least 70% of one type of mine available.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IUIDAB	F12	IUID of the airbase.
MUNTYP	F12	Mix index for this mission.
IACNUM	F12	Number of aircraft requested in DSL.

c. Output Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IAC	Call	The number of aircraft participating in mission.

d. Logical Flow (Figure IV-10-B-8):

(1) Block 1. The mix table index for this mission is a combination of the 1st and 4th characters of MUNTYP.

(2) Block 2. Get the mission mix requirements from data file 7.

(3) Block 3. Only constrain mission resources for rotary-winged aircraft.

(4) Block 4. Does airbase have required number of aircraft available for mission?

(5) Block 5. Adjust the number of aircraft to that quantity available.

(6) Block L100. Does airbase have required number of personnel for available aircraft?

(7) Block 6. Adjust the number of aircraft for available crew.

(8) Block L125. Does airbase have required amount of fuel for current number of aircraft?

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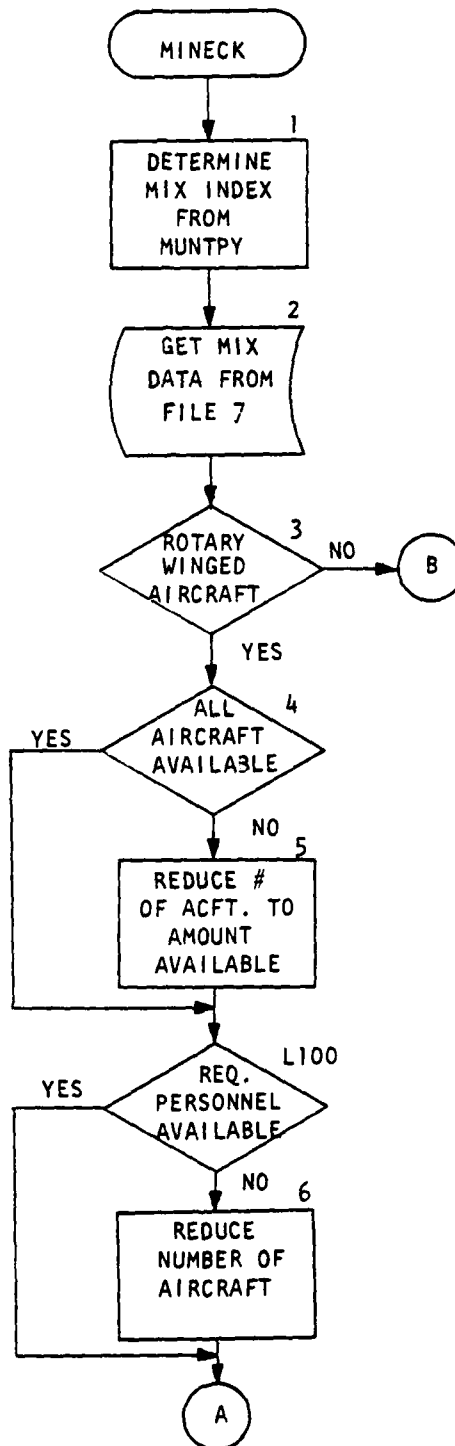


Figure IV-10-B-8. Routine MINECK (Continued next page)

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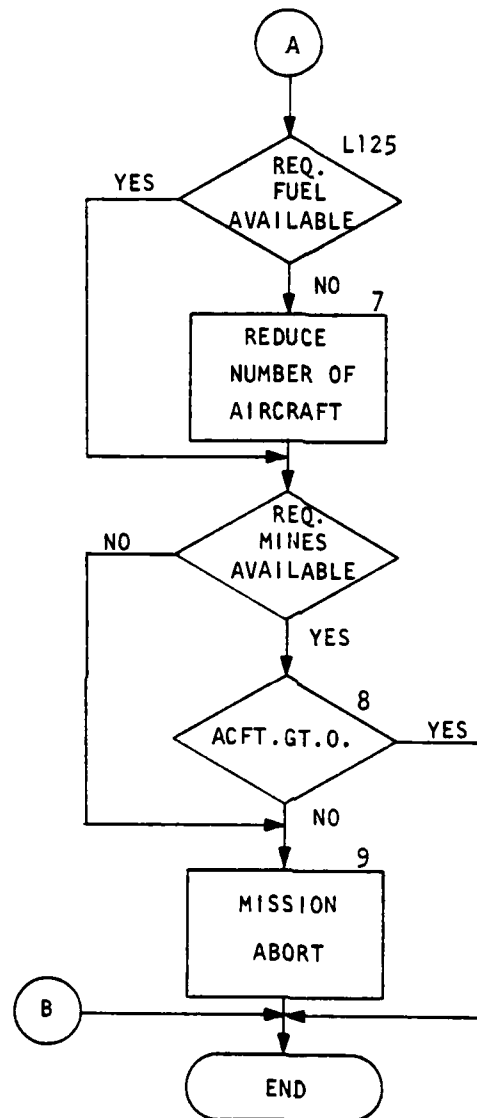


Figure IV-10-B-8. Routine MINECK (Concluded)

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(9) Block 7. Adjust the number of aircraft for available fuel.

(10) Block L150. Is there at least 70% of one of the requested mine types?

(11) Block 8. Has the number of aircraft for this mission been constrained to zero due to lack of resources?

(12) Block 9. Print abort message and terminate the mission.

10. ROUTINE MINELD

a. Purpose. After the creation of the mission unit, routine MINELD loads the types and quantities of resources specified in the mix table for this mission.

Note: The quantities may have been constrained in routine MINECK. MINELD also sets the flight altitude for this mission.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
MUNTYP	FI2	Contains mission indexes.
MIX(11)	TWO	Mix data and mission information.

c. Output Variables:

None

d. Logical Flow (Figure IV-10-B-9):

(1) Block 1. Save pertinent mission data on the mission unit's unit status file.

(2) Block 2. Set the mission units coordinates to those of the supporting air base.

(3) Block L10. Load the mission unit with aircraft, personnel, and fuel. For rotary-wing missions, subtract loaded equipment from the airbase.

(4) Block 3. Load the requested mines on to the mission unit, and subtract from the airbase for a rotary-wing mission.

1 5 APR 1975

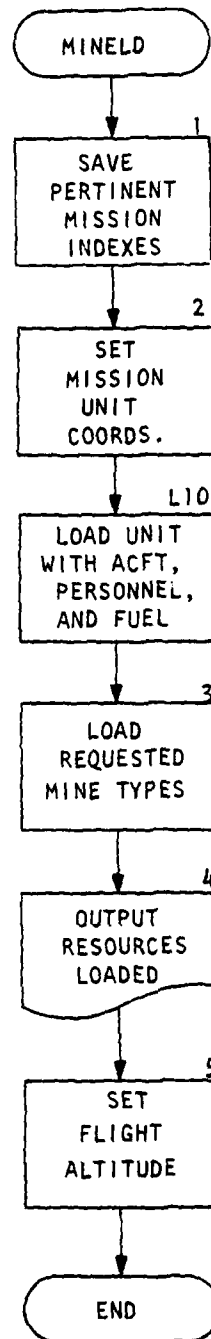


Figure IV-10-B-9. Routine MINELD

IV-10-B-35

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(5) Block 4. Print out those resources now on the mission unit.

(6) Block 5. Break out the flight altitude index from the 4th character of MUNTYP. This index points to the mission flight altitude on file 7.

11. ROUTINE ENRATA:

a. Purpose. This routine acts as an interface between the Air Ground Model and the Ground to Air Attrition Submodel. It is activated when attack helicopter, close air support, or mine delivery missions require penetration of enemy airspace. It determines aircraft losses inflicted by enemy air defense weapons as the aircraft move from a safe point, on the friendly side of the FEBA, to the target area, and their return flight. For a detailed program description of the en route attrition segment of the Air Ground Model please refer to Appendix B of the Airmobile Assault Submodel on page IV-15-B-99.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IUIDMU	File 12	IUID of the mission unit.
TACR	File 12	Total aircraft remaining
MISFLG	File 12	1 - DAFS mission; 2 - CAS mission; 3 - DSL mission; 4 - Mine Delivery mission.

c. Output Variables:

None

d. Logical Flow (Figure IV-10-B-10):

(1) Block 1. Get the aircraft and munition item code table from file 26.

(2) Block 2. Is this the first call to ENRATA for this mission, if not it is a return from the in-flight attrition routines,

1 5 APR 1975

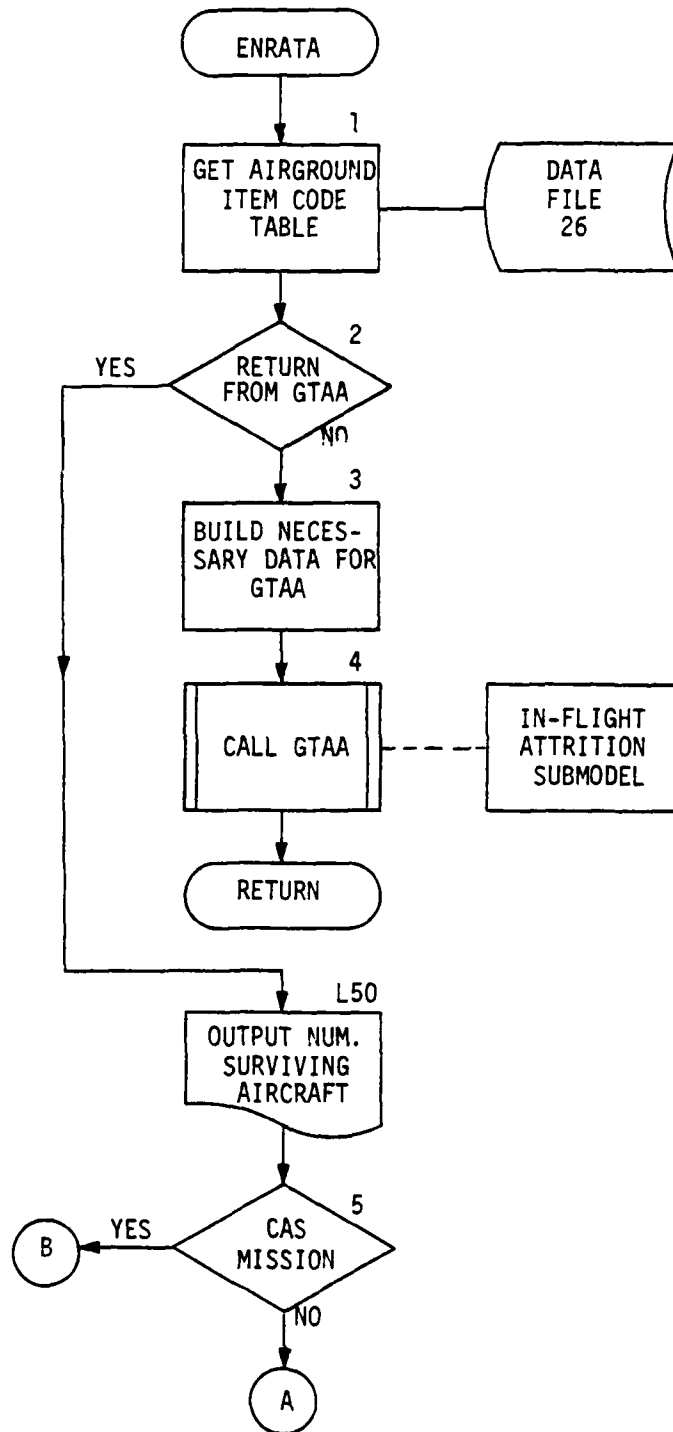


Figure IV-10-B-10. Routine ENRATA (Continued next page)

1 5 APR 1975

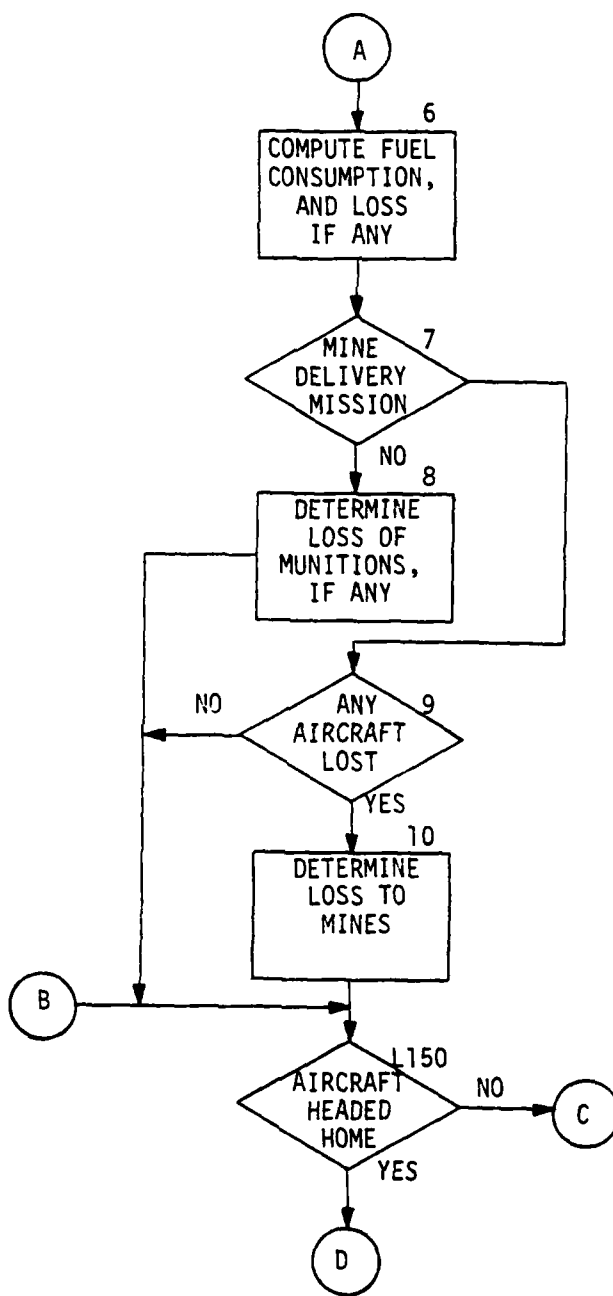


Figure IV-10-B-10. Routine ENRATA (Continued)

1 5 APR 1975

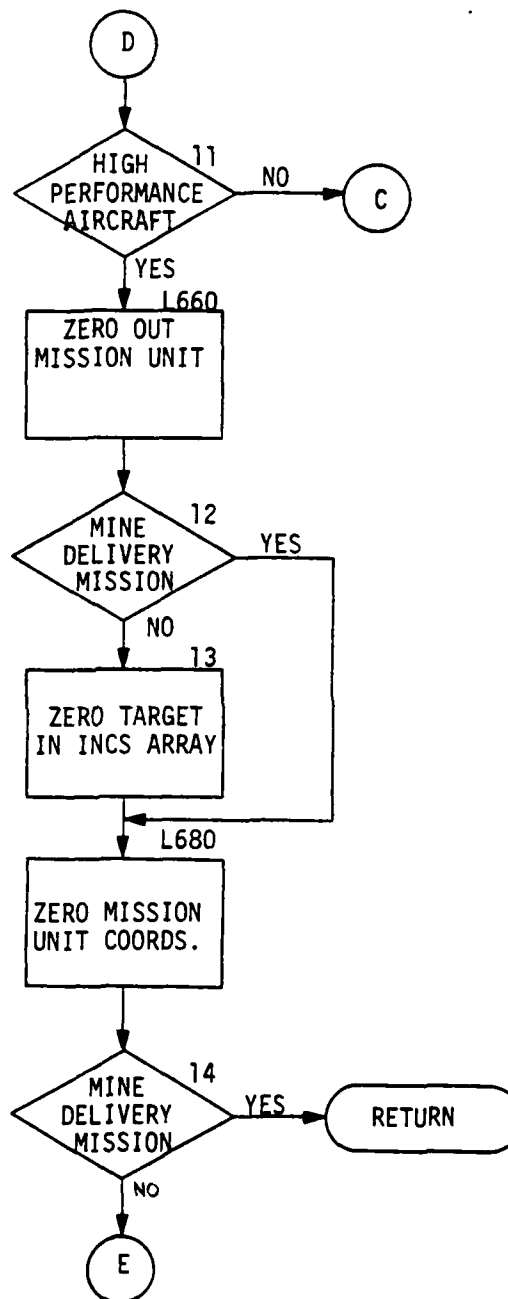


Figure IV-10-B-10. Routine ENRATA (Continued)

1 5 APR 1975

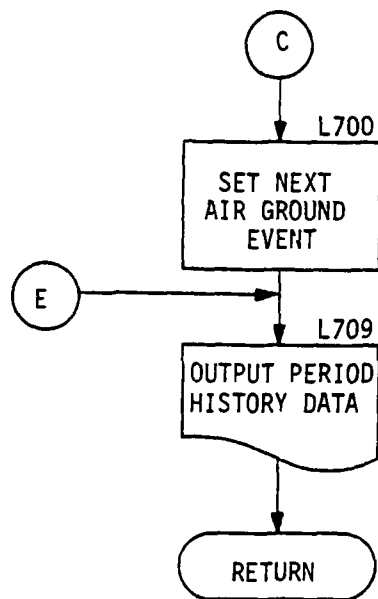


Figure IV-10-B-10. Routine ENRATA (Concluded)

1 5 APR 1975

- (3) Block 3. Set up the File 12 data for the call to the GTAA submodel.
- (4) Block 4. Set an event to enter the GTAA submodel.
- (5) Block L50. Upon returning from GTAA, print the number of surviving aircraft.
- (6) Block 5. Is this a Close Air Support mission?
- (7) Block 6. Compute the fuel consumption for the last flight segment and any fuel loss due to aircraft attrition.
- (8) Block 7. Is this mission a delivery of scatterable mines?
- (9) Block 8. Determine the loss of munitions due to aircraft attrition, if any.
- (10) Block 9. Any aircraft lost to in-flight attrition?
- (11) Block 10. Determine the amount of scatterable mines lost to in-flight attrition.
- (12) Block L150. Has the mission unit completed its task and ready to return to the airbase.
- (13) Block 11. Is this a Close Air Support mission?
- (14) Block L660. Zero and out and release mission unit.
- (15) Block 12. Is this a scatterable mine delivery mission?
- (16) Block 13. Remove the target number from the INC target file, so another mission will not be scheduled until resighted.
- (17) Block L680. Zero the mission units coordinates in common two.
- (18) Block 14. Is this a scatterable mine delivery mission?
- (19) Block 6700. Schedule the next Air Ground event.
- (20) Block L709. Output data to the period history tape.

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12. ROUTINE DRPEXC:

a. Purpose. This routine acts as an executive driver for segment 3 of overlay 4. When entering this routine for a mine air-delivery mission, routine MNEDRP is called, otherwise routine TORA is called.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
MISFLG	F12	The mission flag indicates the type of air mission on this entry.

c. Output Variables:

None

d. Logical Flow (Figure IV-10-B-11):

(1) Block 1. The MISFLG indicates the mission type; 1, 2, or 3 for normal air attack missions and 4 for air-delivery of mines.

(2) Block L100. A call to routine MNEDRP will simulate the release and emplacement of the mines.

(3) Block 2. A call to routine TORA will simulate the air to ground strike.

1 5 APR 1975

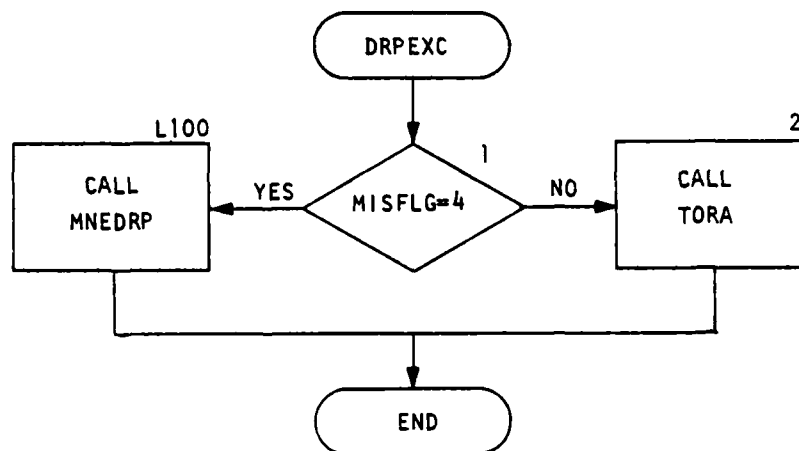


Figure IV-10-B-11. Routine DRPEXC

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13. ROUTINE MNEDRP:

a. Purpose. This routine simulates the delivery/drop of the requested mines. A delivery flight path is computed as parallel to the barrier trace and 1/2 the field depth behind the trace. The ground to air attrition submodel flies the aircraft along the flight path. The number of passes along the flight path is determined by: the number of aircraft on the mission, aircraft velocity, barrier field length, and the mine dispersion rate. At the end of each pass, after attrition to aircraft and respective loss of mines has been deducted, if applicable, a quantity of mines are computed to have been released. An Engineer submodel event is scheduled, to simulate the emplacement of the released mines and thus establish a mine field of density relative to the total quantity of mines released.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IPERS	File 7	Personnel/aircraft for this mission.
IFUEL	File 7	Fuel/aircraft for this mission.
IMINES	File 7	Mine type and quantity for this mission.
DISPRT	File 7	Aircraft dispersion rate.
ISTRIP	File 7	Aircraft strip width.

c. Output Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
TOT (3)	File 12	Total quantity of each mine type delivered on each pass.

d. Logical Flow (Figure IV-10-B-12):

- (1) Block 1. Get the mission unit's unit status file from file 1.
- (2) Block 2. Get the mission mix data from file 7.
- (3) Block 3. Is this the first entry into routine MNEDRP for this mission?

1 5 APR 1975

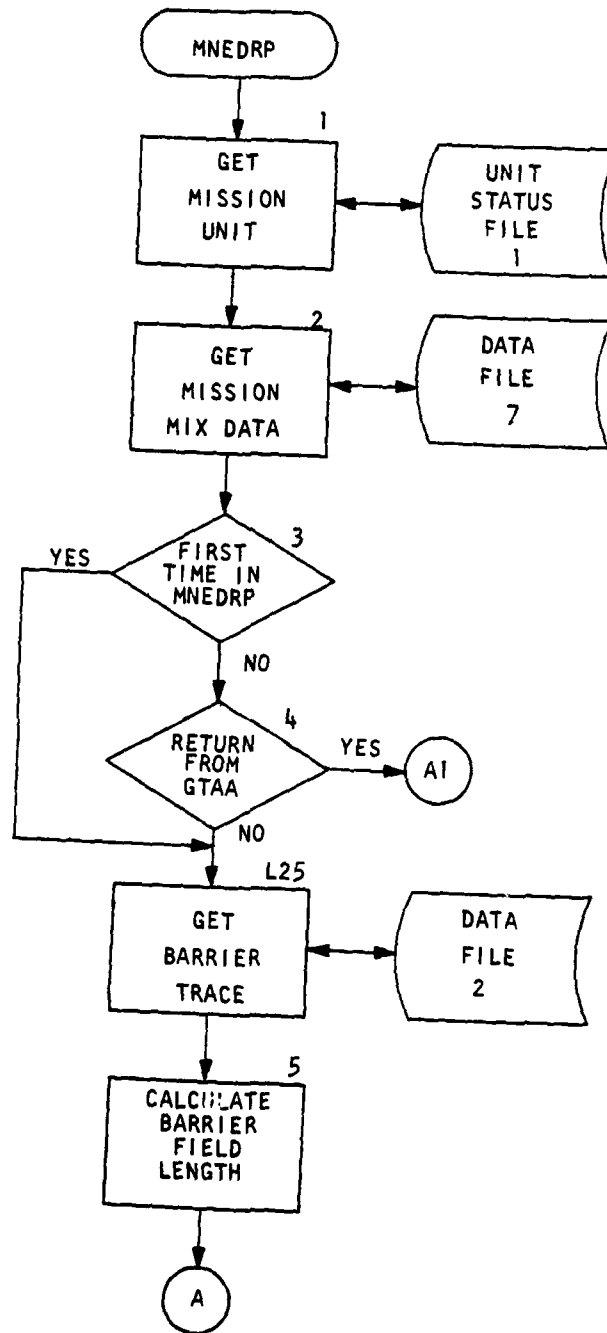


Figure IV-10-B-12. Routine MNEDRP (Continued next page)

15 APR 1975

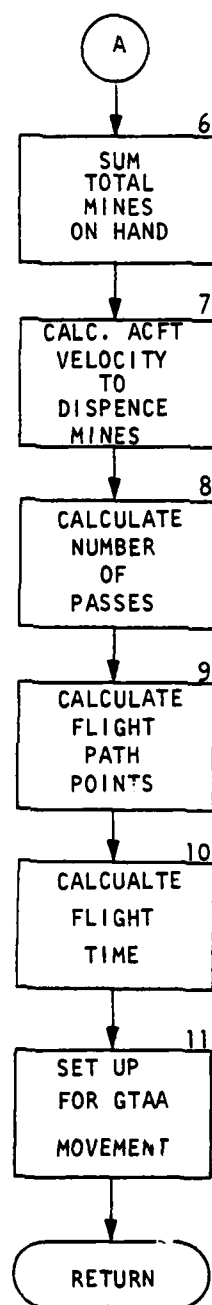


Figure IV-10-B-12. Routine MNEDRP (Continued)

15 APR 1975

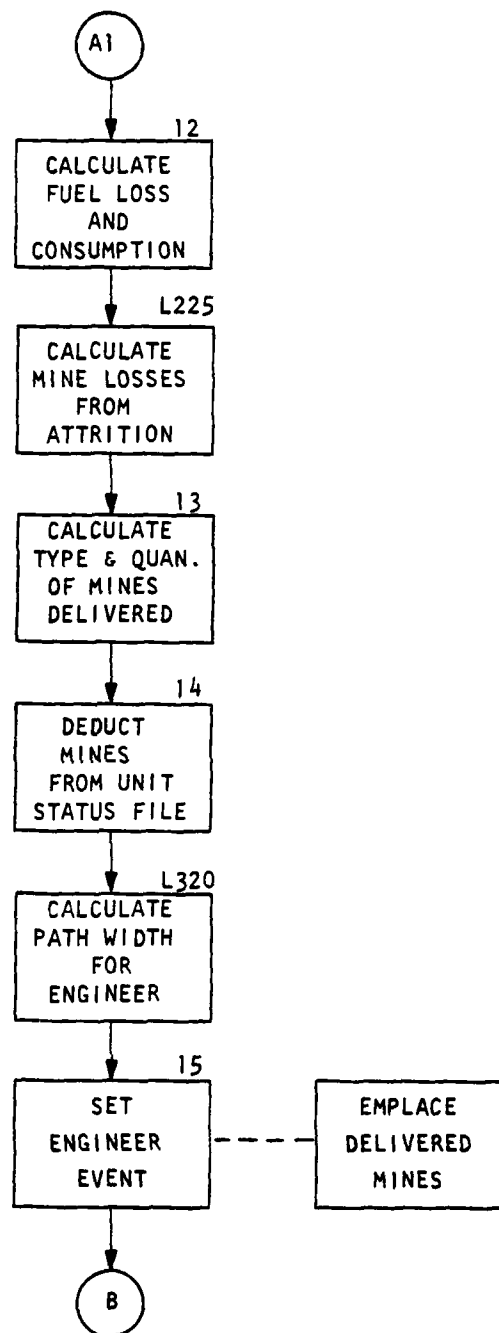


Figure IV-10-B-12. Routine MNEDRP (Continued)

1 5 APR 1975

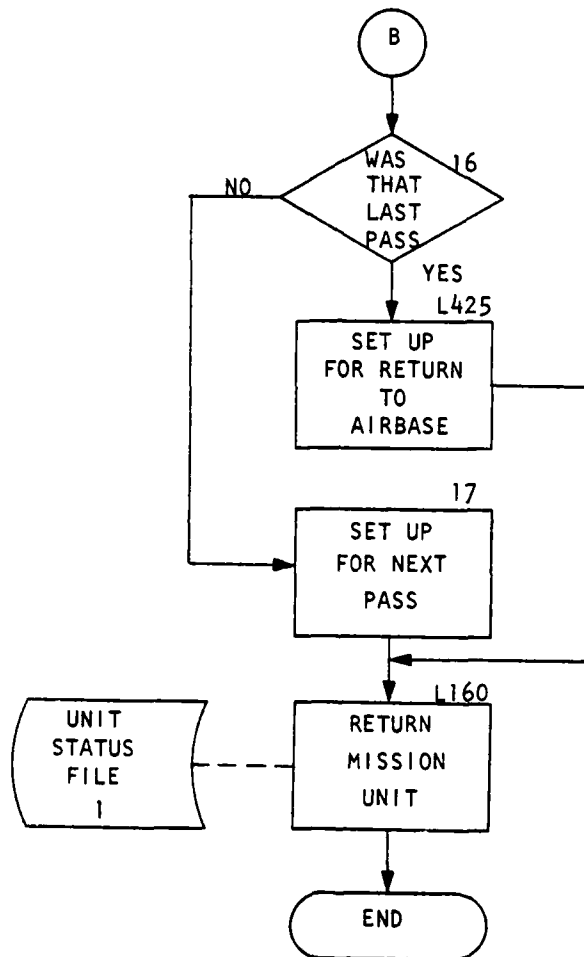


Figure IV-10-B-12. Routine MNEDRP (Concluded)

1 5 APR 1975

- (4) Block 4. Is this the return from GTAA for a flight path pass?
- (5) Block L25. Get the coordinates of the barrier trace from file 2.
- (6) Block 5. Calculate the barrier field length.
- (7) Block 6. Sum the total mines remaining on aircraft by mine type.
- (8) Block 7. Calculate desired aircraft velocity to dispense mines in a given strip width, at a given density.
- (9) Block 8. Calculate number of passes required to dispense all the mines.
- (10) Block 9. Calculate the flight path points as parallel to the barrier trace and $1/2$ the depth behind the trace.
- (11) Block 10. Calculate flight time along flight path.
- (12) Block 11. Set up event for GTAA movement along flight path.
- (13) Block 12. Calculate fuel loss due to GTAA attrition and fuel consumption.
- (14) Block L225. Calculate loss of mines by type due to aircraft attrition.
- (15) Block 13. Calculate the quantity of each type of mine delivered as a function of, aircraft number, velocity, dispersion rate and field length.
- (16) Block 14. Update the unit status file to reflect the current number of mines remaining to be delivered.
- (17) Block L320. Calculate the width of the strip of mines delivered on this pass.
- (18) Block 15. Set an immediate event for the Engineer sub-model to emplace the delivered mines. This will establish a mine field with a given density on the first pass. On subsequent passes the density of the field will increase in relation to the number of mines delivered.

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ARMY COMBINED ARMS COMBAT DEVELOPMENTS ACTIVITY FORT--ETC F/G 15/7
DIVWAS MODEL DOCUMENTATION. VOLUME II. PROGRAMMER/ANALYST MANUA--ETC(U)
JUL 76

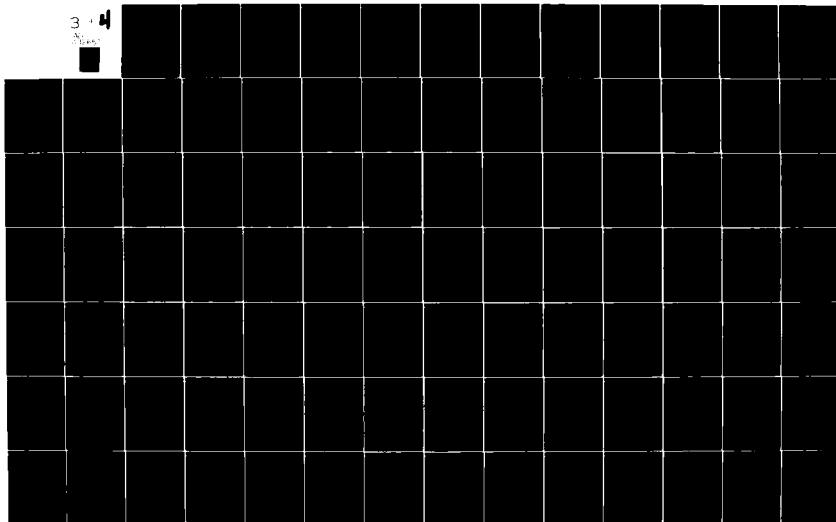
UNCLASSIFIED

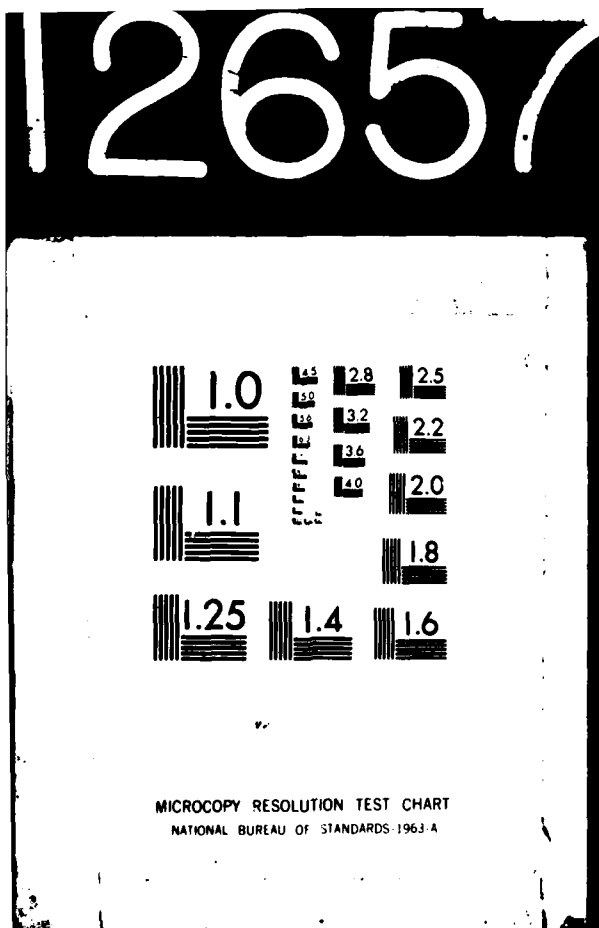
CACDA-TR-8-76-VOL-2-PY-3

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- (19) Block 16. A check is made for the last pass.
- (20) Block L425. After the last pass an event is set up to return the mission unit back to the supporting airbase.
- (21) Block 17. Set an event for the next delivery pass.
- (22) Block L160. Return the mission unit's status file to file 1.

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14. ROUTINE TORA:

a. Purpose. This routine determines results of engagements between aerial attackers and ground-based targets in terms of aircraft losses, aircraft resource losses, and losses inflicted on the target. The engagement results are extracted from a series of tables that are pregame prepared. Data in the engagement results table are adjusted to account for the specific number of aircraft that attack the target and the current strength of the enemy force in the target area.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
TACR	TWO	Total aircraft before attack.
IUIDTG	TWO	Target unit identification.
ESTACT	TWO	Estimated activity of target.
IUIDMU	TWO	Mission unit identification.
MT	TWO	Mission type index.
IPRIOR	TWO	Mission priority.
PERSAV	TWO	Fraction of personnel lost, before attack.
MISFLG	TWO	Flag indicating mission type: 1 = DAFS, 2 = CAS.
PENFLG	TWO	Penetration flat: 0 = no, 1 = yes.
AHENG(36)	DF26	Aircraft engagement parameters.
ABORT(36)	DF26	Aircraft mission abort parameters.
ENGRES(60)	DF27	Engagement results data.
EEQPT(100)	EQUIPT	Equipment codes.
ACAVL(72)	DF26	Aircraft, munitions, air defense weapon item codes.

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<u>Name</u>	<u>Source</u>	<u>Contents</u>
UMAIN(500)	DF1	Unit status record for target/mission unit.
UCOOP(500)	DF1	Unit status record for various air defense units.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
TACR	DF12	Total aircraft after attack.
PERSAV	DF12	Fraction of personnel lost after attack.
IOUT	ONE	Output record containing pertinent attrition data.
UMAIN(500)	DF1	Unit status record for target/mission unit.
UCOOP(500)	DF1	Unit status record for various air defense units.

d. Logical Flow (Figure IV-10-B-13):

(1) Block 1. Bring the unit status record into UMAIN from data file 1 for the target unit.

(2) Blocks 3, 4, 5, and 6. If the mission unit required penetration of enemy airspace to engage the target, bring in the mission abort criteria from data file 26, and check to determine if sufficient aircraft arrived at the target area to continue the attack. If an insufficient number of aircraft survived in-flight attrition to satisfactorily attack the target, a return event is scheduled and control returns to the calling routine.

(3) Blocks 10 and L550. Determine the record index to the engagement results table on data file 27. The index is a function of the mission type index, the activity of the target, and the air defense weapons posture. Bring in the engagement results from data file 27 for the computed index.

(4) Blocks 11 and 12. If data have not been loaded for this index, an error message is printed and the mission unit is returned to the airbase. Control returns to the calling routine.

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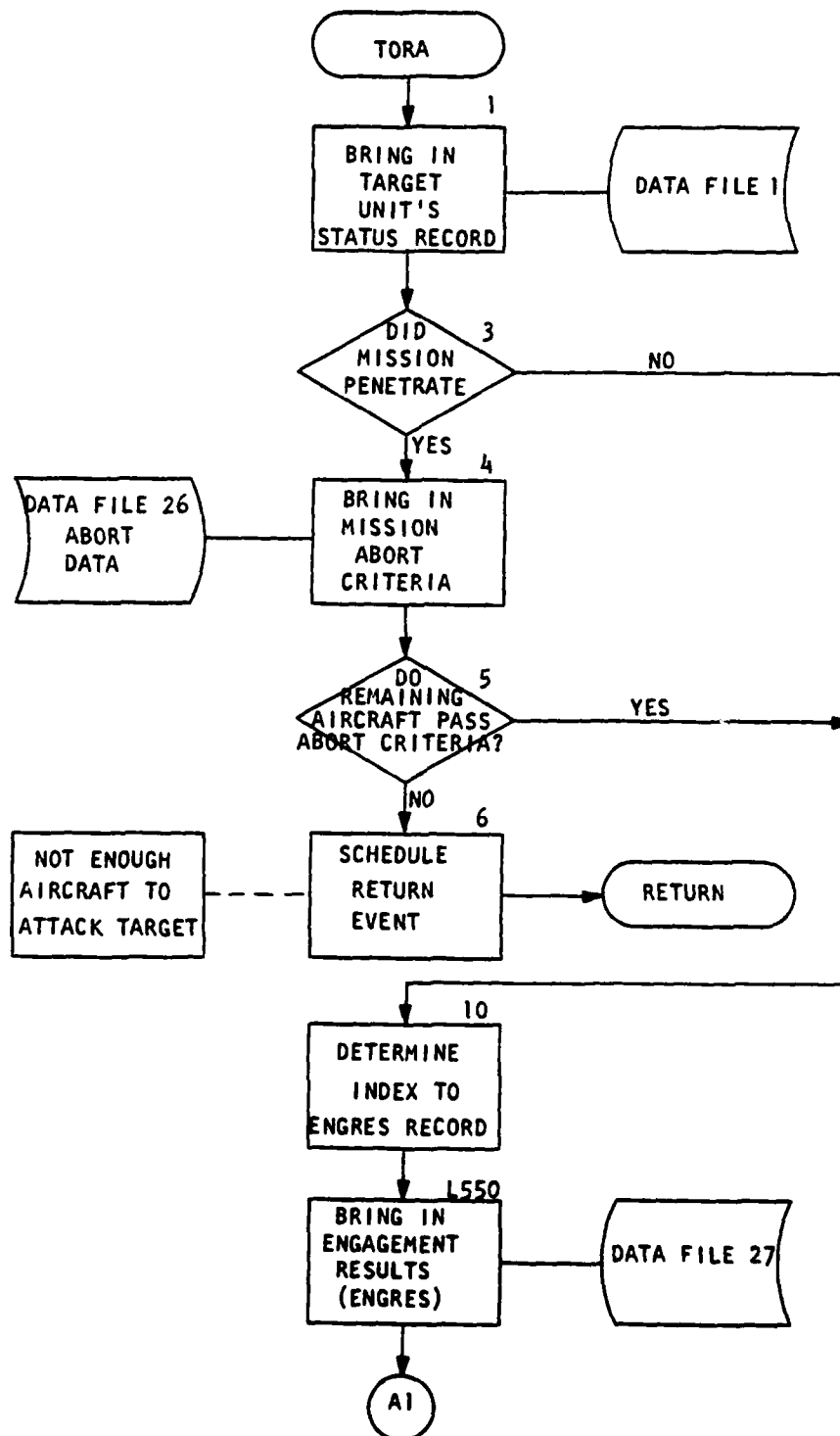


Figure IV-10-B-13. Routine TORA (Continued next page)

IV-10-B-53

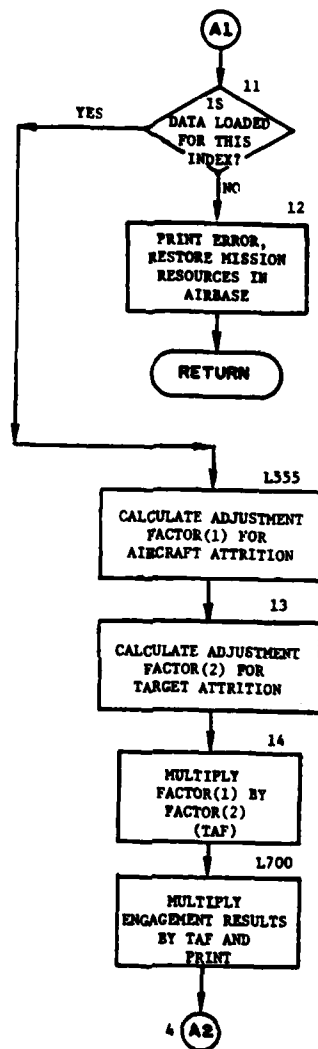


Figure IV-10-B-13. Routine TORA (Continued)

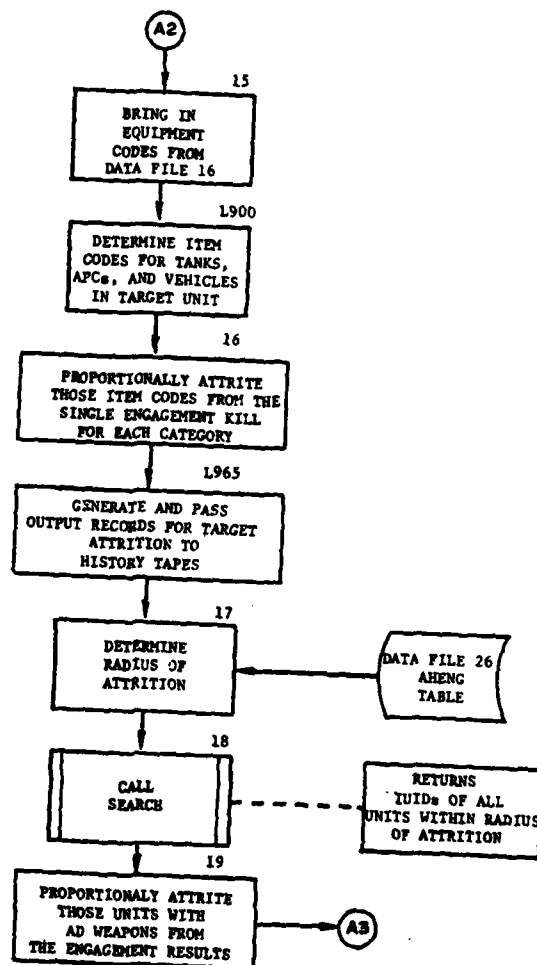


Figure IV-10-B-13. Routine TORA (Continued)

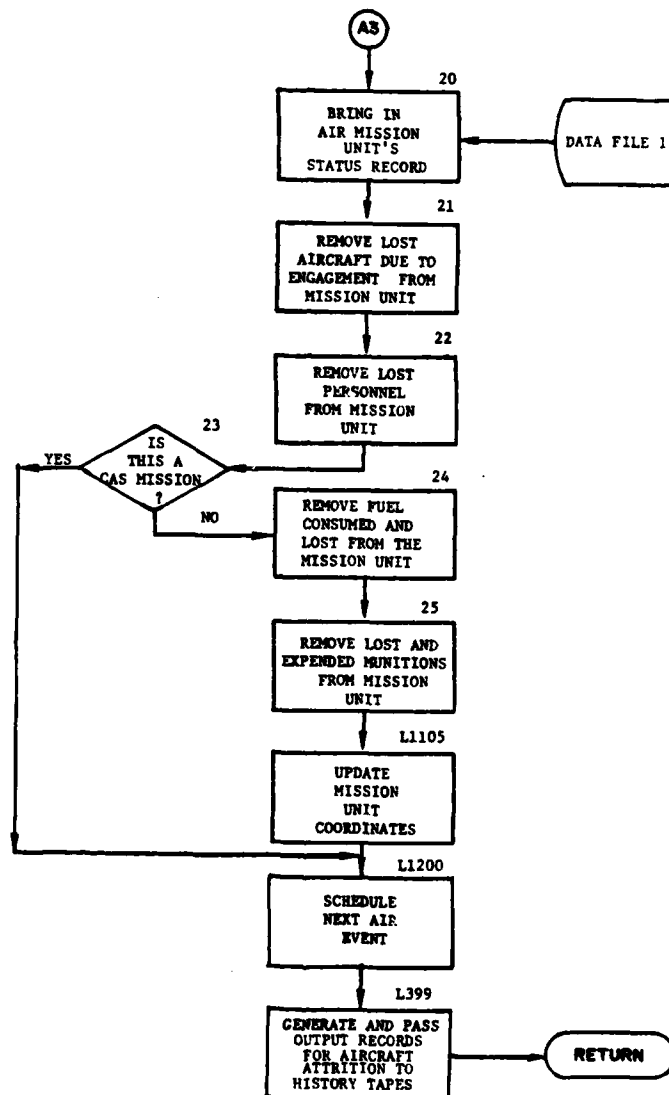


Figure IV-10-B-13. Routine TORA (Concluded)

1 5 APR 1975

(5) Block L555. Aircraft attrition in the target area is based upon engagement results loaded pregame that assume the air mission unit to be full strength. Due to possible attrition en route to the target, the mission unit could arrive at the target area less than full strength; hence, a factor must be computed to degrade the results data proportionally. The adjustment factor is computed by the current number of aircraft in the mission unit divided by the originating number in the unit.

(6) Block 13. An adjustment factor is also computed to degrade the attrition results for the target relative to personnel strength. It is computed by the present strength of the target unit divided by the authorized strength.

(7) Block 14. Multiply the two adjustment factors described in block L555 and block 13 to form a combined adjustment factor.

(8) Block L700. Multiply engagement result entries by the combined adjustment factor.

(9) Blocks 15 and L900. Bring in equipment codes from COMMON IEQPT to identify different types of tanks, vehicles, and APCs. Using the equipment codes, determine the item codes for the types of tanks, vehicles, and APCs.

(10) Block 16. The engagement results data provide a single kill value for all types of a specific category, such as vehicle kills. The kill value is prorated for all types of equipment within that category.

(11) Block L965. Generate an analysis output record containing pertinent information about the attrition to the target area from the air attack.

(12) Blocks 17 and 18. Determine the stand-off distance of the aircraft during the attack from data file 26. Routine SEARCH returns the identifications of enemy units within a given radius, the radius being two times the stand-off distance. From this list all units other than air defense units are filtered out.

(13) Block 19. The engagement results data provided attrition values for air defense weapons by type. The attrition values are then proportionally assessed against those units remaining in block 18, which contain one or more of the specified weapon types.

(14) Block 20. Bring in the air mission unit's status record from data file 1.

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(15) Block 21. Subtract the aircraft losses tabulated in the engagement results data from the mission unit's aircraft.

(16) Block 22. Compute the proportional number of personnel lost due to aircraft attrition and subtract the number from mission unit's personnel.

(17) Blocks 23, 24, and 25. If the mission unit contains attack helicopters, subtract fuel consumed during the attack, fuel lost due to aircraft losses, munitions expended during the attack, and munitions lost due to aircraft losses from the mission unit's fuel and munitions supply.

(18) Block L1105. Update the coordinates of the mission unit to those of the target area.

(19) Block L1200. Schedule an event for the next segment of the mission. If penetration of enemy air space was required to reach the target, the next segment will be en route attrition (ENRATA). If penetration was not required the aircraft will fly back to the airbase (BTF).

(20) Block L399. Generate an analysis output record containing pertinent information about the attrition of aircraft and their resources from the air attack.

15. ROUTINE BTA:

a. Purpose. Routine BTA and routine SEG5 compose mission completion. Routine SEG5 schedules timed events denoting when aircraft will be available for another mission. BTA is activated at each of these preset event times to restore the aircraft back into the availability pool on the airbase.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IUIDAB	TWO	Identification of the airbase unit.
PENFLG	TWO	Flag indicating if the mission unit was required to penetrate enemy airspace to attack the target: 0 = no, 1 = yes.
ACAVL(72)	DF26	Item codes of aircraft.
IUIDTG	TWO	Identification of the target unit.
IUIDMU	TWO	Identification of the mission unit.
IACTYP	TWO	Item code of the aircraft.
UNTLOC(2,1000)	TWO	Unit coordinate list.
UMAIN(500)	DF1	Unit status record of airbase.
UCOOP(500)	DF1	Unit status record of mission unit.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
UNTLOC(2,1000)	TWO	Unit coordinate list.
UMAIN(500)	DF1	Unit status record of airbase.
UCOOP(500)	DF1	Unit status record of mission unit.

d. Logical Flow (Figure IV-10-B-10):

(1) Blocks 1 and 2. If this is the first call to routine BTA for this air mission, routine SEG5 sets the aircraft restoration events and control returns to the calling routine.

(2) Block 3. On second call to BTA bring in the airbase unit status record from data file 1.

(3) Blocks 4, 5, L75, and L80. If this event was scheduled to restore undamaged aircraft to the airbase, restore aircraft, zero out mission unit, and replace the unit status record on data file 1. Remove the target identification from the Intelligence and Control record to eliminate sending multiple air missions to attack the same target.

(4) Block 5A. Decrement the activity counter by the number of aircraft being stored at the airbase.

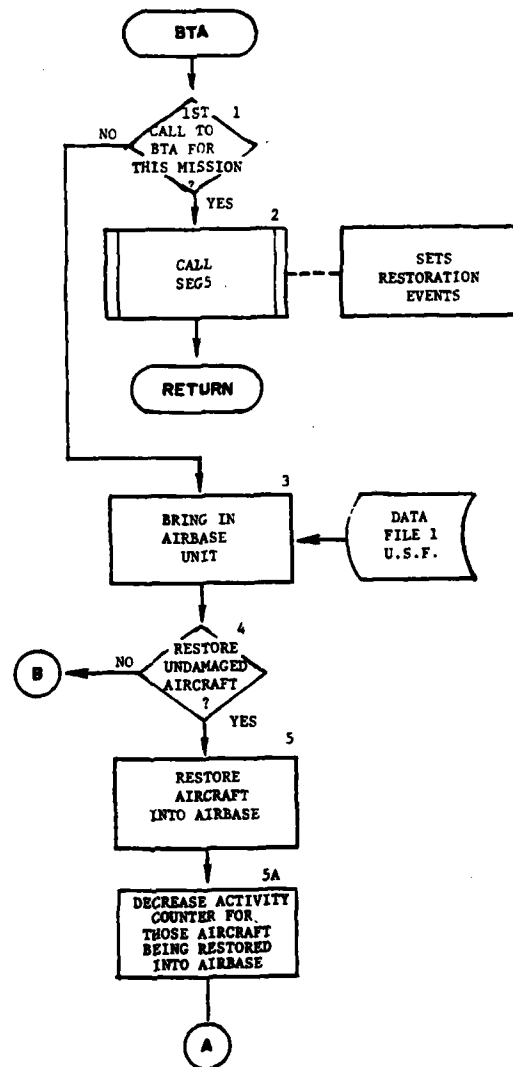


Figure IV-10-B-14. Routine BTA (Continued on Next Page)

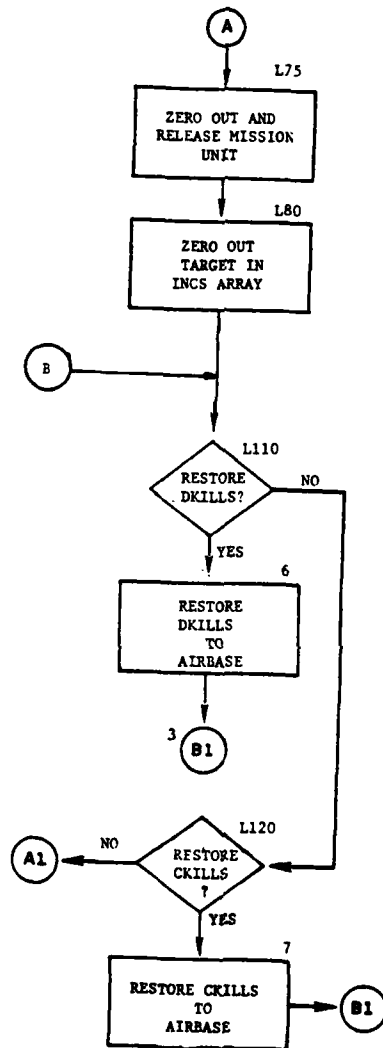


Figure IV-10-B-14. Routine BTA (Continued)

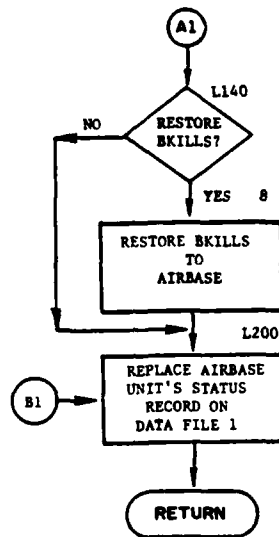


Figure IV-10-B-14. Routine BTA (Concluded)

(5) Blocks L110 and 6. If this event was scheduled to do so, restore aircraft sustaining D-kills to the airbase, and transfer control to block L200.

(6) Blocks L120 and 7. If this event was scheduled to do so, restore aircraft sustaining C-kills to the airbase, and transfer control to block L200.

(7) Blocks L140 and 8. If this event was scheduled to do so, restore aircraft sustaining B-Kills to the airbase, and control goes to block L200.

(8) Block L200. Replace airbase unit's status record on data file 1, and return control to the calling routine.

12. ROUTINE SEG5:

a. Purpose. Routine SEG5 is associated with routine BTA to complete the mission. SEG5 determines the landing time required including taxi time to the aprons used for parking or storing the aircraft at the airbase. By use of a table on data file 26 the routine determines the time when each of the returning aircraft, or recoverable aircraft, can be listed as available for another mission. The availability times in the table permit aircraft without damage to be available as soon as the required post-flight maintenance time for the number of flying hours has passed. Repair time delays are imposed on C- and D-type kills. The availability time for those B-kills that occurred in nonpenetration type missions reflects the total recovery and repair time.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
LANDTM(36)	DF26	Aircraft landing times.
AVALTM(36)	DF26	Aircraft availability times.
ACAVL(72)	DF26	Aircraft item codes.
UNTLOC(2,1000)	TWO	Unit coordinate list.
IUIDTG	TWO	Identification of the target unit.
IUIDMU	TWO	Identification of the mission unit.
MISFLG	TWO	Flag indicating mission type: DAFS = 1, CAS = 2.
PENFLG	TWO	Penetration flag: 1 = yes, 0 = no.
IUIDAB	TWO	Identification of airbase unit.

<u>Name</u>	<u>Source</u>	<u>Contents</u>
TIMF	TWO	Time to fly from the airbase to the FEBA.
TIMT	TWO	Time to fly from the FEBA to the target.
UMAIN(500)	DF1	Unit status record of airbase.
UCOOP(500)	DF1	Unit status record of mission unit.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
IACTYP	DF12	Aircraft item code.
UMAIN(500)	DF1	Unit status record of the airbase.
UCOOP(500)	DF1	Unit status record of the mission unit.

d. Logical Flow (Figure IV-10-B-11):

(1) Block 1. Bring in the unit status records from data file 1 of the airbase and the mission unit.

(2) Blocks 2, 3, 4, 5, and L25. If there are no undamaged aircraft remaining on the mission unit, restore remaining fuel and personnel to the airbase and, if the mission unit contains attack helicopters, restore remaining munitions to the airbase. Zero out mission unit's status record and place it on data file 1.

(3) Block 6. Determine the aircraft landing time as a function of the number of aircraft ready to land and the prevailing weather conditions.

(4) Blocks 7, 8, and 9. If there are undamaged aircraft, the INCOPR code is set to 9 indicating to routine BTA that SEG5 has been called to set restoration events, and the restoration event for undamaged aircraft is scheduled.

(5) Blocks L90, 10, and 11. If the mission did not require penetration of enemy air space and B-kills were sustained, schedule the restoration event for aircraft with B-kills. Set INCOPR code to 6 to indicate a B-kill event.

(6) Blocks L100 and 12. If there are any aircraft on the mission unit that have sustained C-kills, schedule the restoration event for aircraft with C-kills. Set INCOPR code to 7 to indicate a C-kill event.

(7) Blocks L200 and 13. If there are any aircraft on the mission unit that have sustained D-kills schedule the restoration event for aircraft with D-kills. Set INCOPR code to 8 to indicate a D-kill event. Control returns to the calling routine.

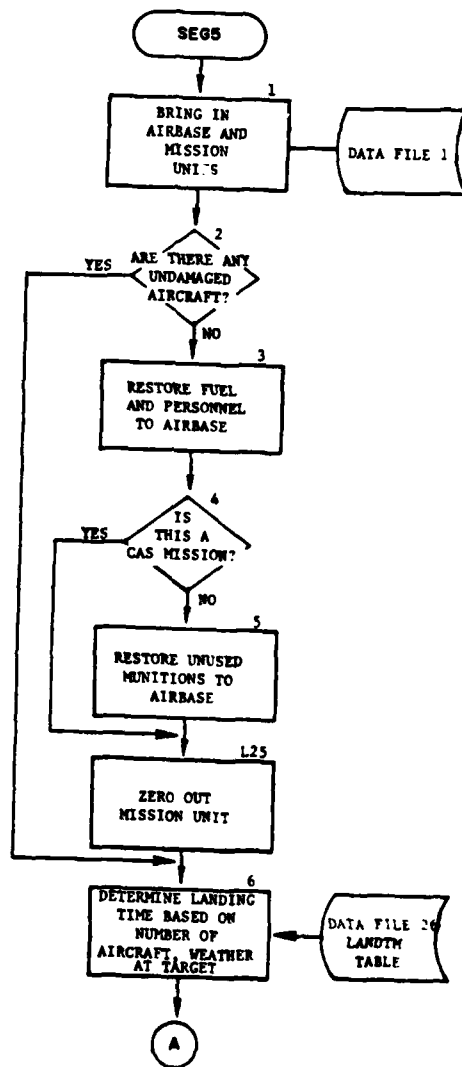


Figure IV-10-B-15 . Routine SEG5 (Continued on Next Page)

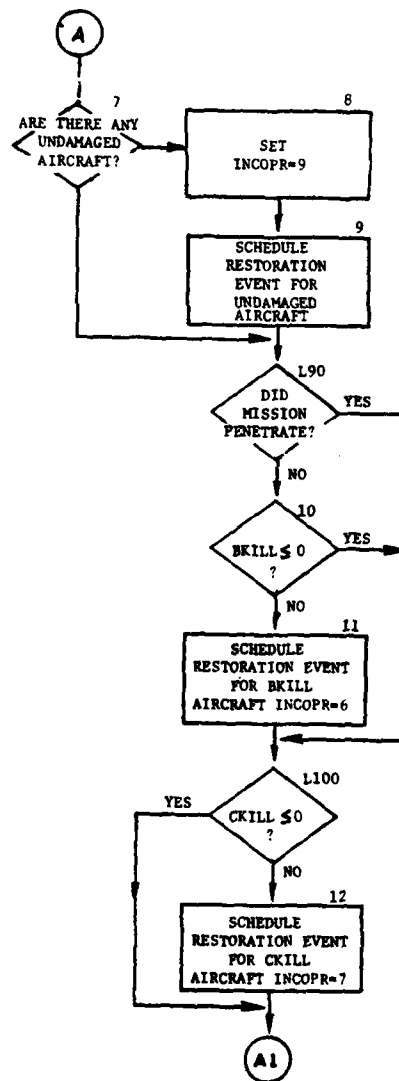


Figure IV-10-B-15. Routine SEG5 (Continued)

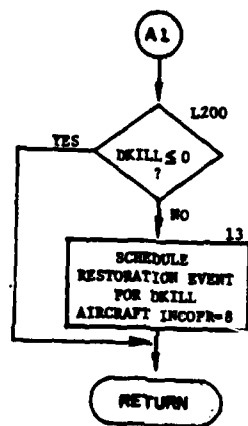


Figure IV-10-B-15. Routine SEG5 (Concluded)

APPENDIX C

AIR GROUND ENGAGEMENT MODEL OUTPUT DESCRIPTIONS

1. INTRODUCTION. This appendix contains samples and detailed descriptions of printed output from the Air Ground Engagement Model of the Period Processor. A figure depicts the format of each printed output; in the figure an alphabetical character (descriptor) designates an appropriate line, group of lines, or column that is explained in following paragraphs. The descriptions will be treated in five major segments. Each segment describes the activity of the air mission at a critical point in the mission, and each air mission follows a prescribed sequence of events. This sequence depends largely on whether enemy air space will be penetrated. At the beginning of each segment of prints an AIR code is printed. This code is listed below and, depending on penetration, indicates which routine will be called to process that segment.

Penetration = 1		Nonpenetration = 0	
<u>Air Code</u>	<u>Routine Called</u>	<u>Air Code</u>	<u>Routine Called</u>
1	ATB	1	ATB
2	BTF	2	BTF
3	ENRATA	3	TORA
4	TORA	4	BTF
5	ENRATA	5-7	BTA
6	BTF		
7-11	BTA		

2. AIR MISSION REQUEST, ROUTINE ATB. This segment schedules the air mission and allocates all resources needed to complete the mission. There will be only one set of print statements from this segment for each mission request. The format of this segment depends on whether it is a DSL ordered mission or an automatically ordered mission.

a. DSL Ordered Missions (Figure IV-10-C-1):

<u>Output Descriptor</u>	<u>Explanation</u>
A	AIR I: I describes the activity of the air mission, depending upon penetration (see paragraph 1.)
B	The following entries appear in every mission request. The prints are from routine ATB. BPOINT: Highest numbered Blue unit IUID. RPOINT: Lowest numbered Red unit IUID. IUID of Target: Self explanatory. ESTX: Estimated x-coordinate of target. ESTY: Estimated y-coordinate of target.

(A) AIR = 1
 BPOINT = 296
 RPOINT = 653
 IUID OF TARGET = 807
 ESTX = 110485
 ESTY = 80423
 MISFLG = 3
 PENFLG = 1
 ICODE = 4
 WEATHER = 8
 IPRIOR = 1
 MTSAVE = 1.000

(B) 4.000
 8.000
 500.000
 0.000
 0.000
 0.000
 0.000
 4.000
 324.000

(C) YOU IS NOW ENTERING LIMITS
 MISSION TYPE = 21
 AIR CRAFT TYPE = 1
 LIMIT FLAG = 0
 AIR BASE IUID = 199
 YOU IS NOW ENTERING AVAIL
 COORDINATES OF AIR BASE = 101430 81103

(D) IAVAIL = 0
 ITYPE = 1
 IEOM = 08
 AMNTAC = 14.0000
 AMNTAC AFTER HARDEN = 14.0000

(E) EOM NUMBER = 98
 EOM NUMBER = 7
 EOM NUMBER = 8
 EOM NUMBER = 8
 EOM NUMBER = 8
 MUNITION AMOUNT = 208.0000
 MUNITION AMOUNT = 8582.0000
 MUNITION AMOUNT = 0.0000
 MUNITION AMOUNT = 0.0000
 MUNITION AMOUNT = 3.0000

Figure IV-10-C-1. DSL Air Mission Request Output (Continued on Next Page)

(F) YOU IS NOW ENTERING PREPTH
 AIR CRAFT TYPE = 1
 NUMBER AIR CRAFT = 4
 PREPARATION TIME = 500
 YOU IS NOW LEAVING PREPTH
 CUID = 010132A2
 CTYP = 20HH

(G) COORDINATES OF MISSION UNIT = 101400.
 STRENGTH OF MISSION UNIT = 639
 STRENGTH AT AIR BASE = 639

(H) MISSION TYPE ECH = 98
 MISSION UNIT AMNT. = 0.00
 MISSION TYPE ECH = 7
 MISSION UNIT AMNT. = 500.00
 MISSION TYPE ECH = 3
 MISSION UNIT AMNT. = 324.00

(I) YOU IS NOW ENTERING TIMES
 SAFE DIST IN FRONT OF FEBA = 20000.0000
 45000.0000
 25000.0000
 200.00
 0000.00
 9500.00

(J) 1.344E+05
 1.096E+05
 2.400E+04
 ESTN = 110405
 ESTV = 80423
 DISTA = 2.402E+04
 DISTV = 4.328E+03
 ANFEBA = 94463
 DIST. FROM AIR BASE TO A = 7.550E+03
 A/C SPEED OVER FRIENDLY TERR. = 130.0000
 BASE TO PT. A TIME = 100
 DIST OF ATTACK FROM TARGET = 3.000E+03
 DIST FROM A TO B = 2.141E+04
 TOTAL TIME FROM AIR BASE TO B = 721
 MISSION START TIME = 004
 TIME A/C MUST BE AT A = 1402
 LEAVING TIMES 500
 DELTIN = 500

(K) AIR BASE UNIT AMNT. = 200.00
 AIR BASE UNIT AMNT. = 0000.00
 AIR BASE UNIT AMNT. = 9500.00

(L)

Figure IV-10-C-1. DSL Air Mission Request Output (Concluded)

Output
Descriptor

Explanation

- MISFLG: 1 = DAFS; 2 = CAS; 3 = DSL ordered (redefined MISFLG 1 or 2 in ATB).
PENFLG: 0 = nonpenetration mission; 1 = penetration mission.
ICODE: Estimated target type.
IPRIOR: Indicates mission priority.
MTSAVE: An array containing the resources used for this mission, same as pregame data load for this mission type.
- C Routine LIMITS is called to check if the mission type is within range.
MISSION TYPE: Mission type which has a range of 1-40. This statement appears in routine LIMITS.
AIRCRAFT TYPE: Self explanatory. This statement appears in routine LIMITS.
MISSION TYPE OUT OF RANGE 1-40, MT = X: This message will appear only when the limits are exceeded by the present mission. This statement appears in routine LIMITS.
LIMIT FLAG: Flag sent in routine LIMITS. This statement appears in routine ATB.
- D AIR BASE IUID = I : Self explanatory. This statement appears in routine ATB.
YOU IS NOW ENTERING AVAIL: Routine AVAIL has been called. This statement appears in routine AVAIL.
COORDINATES OF AIRBASE = X Y : Self explanatory. This statement appears in routine AVAIL.
ITYPE = I : Type of aircraft needed for the mission. This statement appears in routine AVAIL.
IEOH = I : Item code of the aircraft. This statement appears in routine AVAIL.
AMNTAC = X : Number of aircraft assigned to airbase. This statement appears in routine AVAIL.
AMNTAC AFTER HARDSN = X : Number of aircraft on the airbase after degradation due to preventive maintenance. This statement appears in routine AVAIL.
IAVAIL = I : 0 = airbase satisfies all resource requirements; 1 = all resource requirements cannot be met, diagnostic print will precede. This statement appears in routine AVAIL.
- E If the airbase has the correct munition type and quantity requested for the mission, this entry is printed. There will be one line for each munition type. The first variable of each line is the item code of the munition; the second variable of each line is the total quantity available on the airbase. If the airbase cannot satisfy the mission requirement, an informative message is printed. This statement appears in routine AVAIL.

Output
Descriptor

Explanation

- F Routine PREPTM is called. A mission initiation delay time will be computed.
AIRCRAFT TYPE = I : Self explanatory.
NUMBER AIRCRAFT = I : Number of aircraft needed for the mission.
This statement appears in routine PREPTM.
PREPARATION TIME = I : Time is given in centiminutes. It is a function of aircraft type and quantity. This statement appears in routine PREPTM.
- G Routine ATB is assigning a mission unit to the airbase. The airbase is in UMAIN, the mission unit is in UCOOP.
CUID = A : The new unit identification code assigned to the mission unit. ATB assigns this code. This statement appears in routine ATB.
CTYPE = A : Mission unit's type designator. This statement appears in routine ATB.
IUIDMU = I : IUID of the mission unit assigned by function IUIDF. This statement appears in routine ATB.
COORDINATES OF MISSION UNIT = X, Y : At this point in the mission these coordinates are the same as the airbase coordinates. This statement appears in routine SELECT.
STRENGTH OF MISSION UNIT = I : The number of aircraft in the mission unit is equal to the number required in the mission request. This statement appears in routine SELECT.
STRENGTH AT AIRBASE = I : Self explanatory.
- H There is one line for each munition type required by the mission.
The first variable of each line is the item code of the munition type. The second variable is the amount of munitions given to the mission unit. The third variable is the amount of munitions of that type available to the airbase.
- I Routine TIMES is called to determine various segments of the air mission flight path and time consumed by flying over each segment.
SAFE DIST IN FRONT OF FEBA = X Y Z : X is the safe distance from the enemy front unit; Y is the maximum effective range of any air defense weapon; Z is the distance behind the FEBA at which the aircraft will be invulnerable to enemy air defense weapon fire.
IUID OF FRONT ENEMY UNIT IS I : The enemy closest to the FEBA. This statement appears in routine TIMES.
SLOPE = X : Slope of the FEBA. This statement appears in routine TIMES.
THETA = X : The arctangent of SLOPE.
DIST. FROM A TO TARGET = E : The distance from the safe point to the target.

Output
Descriptor

Explanation

- J Half the depth of the enemy battalion nearest the FEBA is added to the safe point to give a safe distance from the unit's front. The projection of this distance on the X axis is printed on the first line of this entry. The second line of this entry is the X intercept of a line parallel to the FEBA and passing through the target. The third line of this entry is the X intercept of a line parallel to the FEBA and passing through the safe point. The fourth line is the projection on the X axis of the distance from the safe point to the FEBA.
- K ESTX = X : Estimated X coordinate of the target.
ESTY = Y : Estimated Y coordinate of the target.
DISTX = E : Distance in the X direction from the safe point to the target.
DISTY = E : Distance in the Y direction from the safe point to the target.
AXFEBA = X AYFEBA = Y : The X and Y coordinates of the safe point.
DIST. FROM AIRBASE TO A = E : Distance from the airbase to the safe point.
A/C SPEED OVER FRIENDLY TERR. = X : Self explanatory.
BASE TO PT. A TIME = I : Time to fly from the airbase to the safe point in centiminutes.
DIST OF ATTACK FROM TARGET = E : The distance the aircraft is from the target when the engagement takes place (the stand-off distance).
DIST FROM A TO B = E : The distance from the safe point to the stand-off point.
TOTAL TIME FROM AIRBASE TO B = I : The total time of flight from the airbase to the stand-off point in centiminutes.
MISSION START TIME = I : Game time in centiminutes the mission is to begin.
TIME A/C MUST BE AT A = I : Game time in centiminutes the aircraft must be at the safe point.
- L DELTIM = I : Preparation time before mission can begin. This time is the same as the preparation time in descriptor F.

The following are print statements that can appear in this segment but are not shown in the above examples.

7	2						
2	4	0	50	50	0		

ALL WETH SORTIES USED FROM PERIOD I
SORTIES LEFT 46

- . The first line in this entry lists the hour and the force.
- . The second line lists: (1) the index used to find the appropriate sorties table, (2) the number of aircraft involved, and (3) the four words being used from the sorties table.
- . The third line indicates the type of sorties to be flown. I indicates the sorties table index.
- . The fourth line indicates number of sorties of this type remaining in this sorties table after aircraft have been subtracted.

	7	2				
	2	4	0	50	50	0
GD. WETH SORTIES USED FROM PERIOD				2		
SORTIES LEFT		46				

This entry is the same as above with the exception of the sorties type. This entry indicates a good weather sortie type as opposed to an all weather sortie type above.

b. Automatically Ordered Missions (Figure IV-10-C-2):

<u>Output Descriptor</u>	<u>Explanation</u>
A	Same as DSL ordered mission request (subparagraph a above).
B	A DSL ordered mission prespecifies the airbase. If the mission is requested by the Intelligence and Control Model an airbase must be selected. This entry is a list of all available airbases. This statement appears in routine ATB.
C	This entry lists the coordinates of each airbase listed in descriptor B above. This statement appears in routine ATB.
D	Same as DSL ordered mission request (subparagraph a above).
E	<p>The airbases are ranked according to nearness to the target. A search of each airbase is made in ranking order to determine if it can satisfy the requirements of the mission request. If an airbase cannot meet these requirements, a message is printed and the next airbase is searched.</p> <p>AIRBASE IUID = I : Self explanatory. This statement appears in routine ATB.</p> <p>YOU IS NOW ENTERING AVAIL: Routine AVAIL has been called. This statement appears in routine AVAIL.</p> <p>ITYPE = I : Type of aircraft needed for the mission. This statement appears in routine AVAIL.</p> <p>IEOH = I : Item code of the aircraft. This statement appears in routine AVAIL.</p> <p>AMNTAC = X : Number of aircraft assigned to the airbase. This statement appears in routine AVAIL.</p>

```

ATP
RPOINT = 244
RPOINT = 655
INIT OF TARGET = ACA
ESTY = 120904
ESTY = 04615
MISFLG = 1
PENFLG = 0
ATP BASE = 2P
  29
  34
  35
  36
  140
  141
  174
  195
  199
  247
  272
  285
  286
COORDINATES OF ATP BASE = 104800 75200
COORDINATES OF ATP BASE = 104800 65200
COORDINATES OF ATP BASE = 105200 77700
COORDINATES OF ATP BASE = 107500 90200
COORDINATES OF ATP BASE = 116200 71200
COORDINATES OF ATP BASE = 102500 83500
COORDINATES OF ATP BASE = 102500 83500
COORDINATES OF ATP BASE = 94800 95100
COORDINATES OF ATP BASE = 95100 94900
COORDINATES OF ATP BASE = 95900 90700
COORDINATES OF ATP BASE = 94800 95100
COORDINATES OF ATP BASE = 95700 76400
COORDINATES OF ATP BASE = 94700 76400
COORDINATES OF ATP BASE = 75100 68500
ICODE = 4
WEATHER = 0
IPRICE = 1
MISAVE = 1.000
  2.000
  4.100
  250.000
  0.000
  0.000
  0.000
  0.000
  2.000
  162.000
YOU IS NOW ENTERING LIMITS
MISSION TYPE = 1
ATP CRAFT TYPE = 1
LIMIT FLAG = 0
ATP BASE YTD = 35
YOU IS NOW ENTERING AVAIL
COORDINATES OF ATP BASE = 107500 90200
IAVAIL = 0
ITYPE = 1
IFOM = 44
AMNTAR = 0.0000
AMNTAR AFTER WARDSN = 0.0000
ATCRAFT TYPE = 1 NOT AVAIL AT ATP BASE
LIMIT FLAG = 0
ATP BASE YTD = 34
ATP BASE YTD = 141
YOU IS NOW ENTERING AVAIL
COORDINATES OF ATP BASE = 102500 83500
IAVAIL = 0
ITYPE = 1
IFOM = 44
AMNTAR = 0.0000

```

Figure IV-10-C-2. Automatic Air Mission Request Output

Output
Descriptor

Explanation

AMNTAC AFTER HARDSN = X : Number of aircraft on the airbase after degradation due to preventive maintenance. This statement appears in routine AVAIL.
AIRCRAFT TYPE I NOT AVAIL AT AIRBASE or
MUNITION TYPE I NOT AVAIL AT AIRBASE: Routine AVAIL checks the airbase for availability of aircraft and munitions. If the airbase does not have sufficient munitions or aircraft to complete a mission the appropriate message is printed and control returns to the calling routine.
IAVAIL = I : 0 = airbase satisfies all resource requirements; 1 = all resource requirements cannot be met, diagnostic print will precede.
LIMIT FLAG = I : Flag set in routine LIMITS.
AIRBASE IUID = I : The first airbase checked that can satisfy mission requirements. This airbase will be used for the mission. This statement appears in routine AVAIL.
YOU IS NOW ENTERING AVAIL: Routine AVAIL has been called. This statement appears in routine AVAIL.
COORDINATES OF AIRBASE = X Y : Coordinates of the airbase that will fly this mission.

The remaining printout format of the mission request segment is identical to the DSL ordered mission shown in Figure IV-10-C-1, descriptors E through L, and described in subparagraph a above.

3. EN ROUTE ATTRITION - ROUTINE ENRATA. This segment of prints lists information needed to determine losses to aircraft from enemy ground fire. There are two sets of print statements from this segment for each completed mission. The first set of prints represents the aircraft from the safe point to the target, the second set represents the return flight. The format remains the same for both sets, and is shown in Figure IV-10-C-3. The explanation for each descriptor in the figure is as follows:

Output
Descriptor

Explanation

- A This entry describes the activity of the air mission unit. In this case the activity is the attrition of aircraft en route to target. This statement appears in routine AIRGND.
- B ENTERING PROGRAM ENRATA: The en route attrition routine ENRATA has been called.
IUIDTG = IUID of the target unit.
ESTX = Estimated X coordinate of the target.
ESTY = Estimated Y coordinate of the target.
IUIDMU = IUID of the mission unit.
MT = Mission type.
TACR = Total aircraft remaining after the attack.
JZONE = Number of zones the mission penetrates.

<p>(A) ENTERING PROGRAM ENRATA</p> <p>TUJDTG = 835</p> <p>ESTR = 114902</p> <p>ESTV = 88565</p> <p>TUJDMU = 298</p> <p>MT = 21</p> <p>TACP = 4.000000</p> <p>JZONE = C</p> <p>MISFLG = 1</p> <p>AXPERA = 94186</p> <p>AYFEBA = 82833</p> <p>ABOIST = 18050.00</p> <p>TUJDA8 = 199</p> <p>XOIST = 20000.00</p> <p>WEATHER = 0</p> <p>WEATHER CODE = 0</p> <p>JZONE = 3</p> <p>2.300E+04</p> <p>3.000E+03</p> <p>1.205E+04</p>	<p>(B)</p>	<p>(C)</p>	<p>(D)</p>	<p>(E)</p>
---	-------------------	-------------------	-------------------	-------------------

<p>FLIGHT PATH CROSSES THESE CELLS</p> <p>6199</p> <p>6353</p> <p>6507</p> <p>8.464E-01</p> <p>8.464E-01</p> <p>8.464E-01</p> <p>8.464E-01</p> <p>8.464E-01</p> <p>0.</p> <p>0.</p> <p>6.500E-01</p> <p>0.</p> <p>0.</p>	<p>6201</p> <p>6355</p> <p>6509</p>	<p>6202</p> <p>6356</p> <p>6510</p>	<p>4152</p> <p>6357</p>
--	-------------------------------------	-------------------------------------	-------------------------

<p>FLIGHT PATH CROSSES THESE CELLS</p> <p>6516</p> <p>8.667E-01</p> <p>0.</p>	<p>6528</p>
---	-------------

Figure IV-10-C-3. En Route Attrition Printed Output from Air Ground Engagement Model (Continued on Next Page)

Output
Descriptor

Explanation

- MISFLG = Indicates type of air support; 1 = TACAIR, 2 = attack helicopter.
AXFEBA = X coordinate of the safe point.
AYFEBA = Y coordinate of the safe point.
ABDIST = Distance over which the aircraft attrition will be determined.
IUIDAB = IUID of the airbase.
XDIST = Distance the safe point is from the FEBA.
- C Routine WETTHR is called to determine the weather code of the target.
WEATHER = I : I equals the weather code 0-3. This statement appears in routine WETTHR.
X-Y COORD NOT WITHIN A WEATHER SECTOR = This print occurs only when weather data have not been supplied for the sector in which the target is estimated to be. This statement appears in routine WETTHR.
WEATHER CODE = I : I equals the weather code 0-3 at the target. This statement appears in routine ENRATA.
- D JZONE = I : The number of zones the mission will penetrate is determined and printed. The remaining entries are the distances traveled in each zone. The total number of distances corresponds to the number of cells.
- E Routine CELLST is called to determine the cells crossed by the flight path.
FLIGHT PATH CROSSES THESE CELLS: This message appears once for each zone penetrated above (JZONE). The line immediately below this lists the cells crossed in that zone. The remaining entries are the terrain degradation factors for each air defense weapon. This statement appears in routine ENRATA.
- F This entry lists the total width across all enemy divisions. This statement appears in routine ENRATA.
- G This entry gives the area of the air zone penetrated. The number of areas printed corresponds to JZONE. This statement appears in routine ENRATA.
- H NUMBER OF AD WEAPONS DETECTED = X : The entries immediately following this line are the item codes of the air defense weapons detected. The total number of item codes listed corresponds to X. This statement appears in routine ENRATA.
- I The first column of entries is item codes of the air defense weapons listed above (Descriptor H). The second column is the item code of the munition used by each air defense weapon.

Output
Descriptor

Explanation

The third column is the maximum effective range. This statement appears in routine ENRATA.

- J ZNCEPS = X-- Y-- : This entry lists the X intercept of each zone boundry. There is one entry for each zone penetrated. This statement appears in routine ENRATA.
- K The first entry on the first line is the unit identification number (IUID) of the air defense unit. The second entry is the zone in which the air defense unit is found. The entry on the second line is the distance the air defense unit is from the flight path. The print statements discribed above are repeated once for each air defense unit within range of the flight path. This statement appears in routine ENRATA.
- L This entry gives the number of weapons per zone by type. There will be one line for each zone penetrated. This statement appears in routine ENRATA.
- M This entry gives the amount of munitions by weight for each zone. There is one line for each zone penetrated. This statement appears in routine ENRATA.
- N JZONE = I : The number of zones the mission will penetrate is determined and printed. The remaining entries are the distances traveled in each zone. The total number of distances corresponds to the number of cells. This statement appears in routine ENRATA.
- O This entry lists all terrain degradation factors. This statement appears in routine ENRATA.
- P This entry gives the density of weapons per zone by type. There is one line for each zone penetrated. This statement appears in routine ENRATA.
- Q This entry gives the number of air defense weapons by type eligible to fire. The degradation factors dealing with posture of the enemy, attacking or defending unit, and with speed of the aircraft are reflected in the second entry. This statement appears in routine ENRATA.
- R This entry is the total number of weapons eligible to fire after being degraded by weapon accuracy factors found on data file 26. This statement appears in routine ENRATA.

Output
Descriptor

Explanation

- S This entry is the number of rounds by weapon type that will hit a one meter square area.
- T This entry gives the probability of survival for each aircraft type. Each line in this entry corresponds to one of the four kill categories. This statement appears in routine ENRATA.
- U This entry gives the number of kills by kill category. The kills are as follows: A - catastrophic, B - forced landing, C - damaged but flyable, D - slightly damaged. This statement appears in routine ENRATA.
- V The first entry gives the total fuel consumed from the FEBA to the target. This value is subtracted from the mission unit's total. The second entry is the number of personnel lost due to aircraft kills. The third entry contains fractions of personnel killed. This total is accumulated until the end of the mission and then expended. The fourth entry is the amount of fuel the mission unit has remaining after fuel lost due to aircraft damage has been calculated. This statement appears in routine ENRATA.
- W NO. A/C = X : This entry gives the total number of aircraft available to the mission unit to fly this mission.
TACR = X : This entry gives the total number of aircraft that reach the target with no damage.
NO. A/C REMAINING: This entry gives the total number of flyable aircraft remaining at the target. The difference between entry three and entry four is that entry three does include C-type kills while entry four does not. This statement appears in routine ENRATA.
- X MUNITIONS LOST = X : This entry appears if there is an attack helicopter mission. X is the amount of munitions lost due to aircraft kills. There is one entry for each munition type. This statement appears in routine ENRATA.
- Y This entry gives the updated mission unit coordinates. These coordinates are those of the target area. This statement appears in routine ENRATA.
- Z This entry gives the number of rounds fired by each air defense weapon type. This statement appears in routine ENRATA.

4. ENGAGEMENT RESULTS - ROUTINE TORA. This segment of prints lists losses resulting directly from the engagement. These losses include losses to aircraft and aircraft resources and losses inflicted on the target. There will be one set of print statements from this segment for each complete mission. The engagement results format, illustrated in Figure IV-10-C-4, is the same regardless of the mission type. The explanation for each description in the figure is as follows:

<u>Output Descriptor</u>	<u>Explanation</u>
A	<p>ENTERING TORA: The target engagement routine has been called.</p> <p>TGT = I: IUID of the target being assessed.</p> <p>EST ACTVTY = I: The estimated activity of the target.</p> <p>MT = I: The mission type index.</p> <p>JZONE = I: Total number of zones the mission penetrates.</p> <p>PRIORITY = I: Indicates mission priority.</p> <p>INDEX = I: The engagement results table index.</p> <p>AC = X: Total number of aircraft that began the mission.</p> <p>AF = X: An adjustment factor computed by dividing the current number of aircraft by the number that started the mission.</p> <p>PCNTTG = X: The percent of aircraft remaining. It is computed by dividing present strength by authorized strength.</p>
B	<p>TAF = X: An adjustment factor used to compute losses. It is found by multiplying AF by PCNTTG.</p>
C	<p>Each entry in the engagement results table is multiplied by the adjustment factor. The results appear in this print statement representing the friendly losses. There is one entry for each equipment type in the table.</p>
D	<p>Each entry in the engagement results table is multiplied by the adjustment factor. The results appear in this print statement representing the enemy losses. There is one entry for each equipment type in the table.</p>
E	<p>The total kills for each category of equipment are prorated for all types of equipment in that category. This print statement lists the item code and total number of kills by type. The categories are as follows: TKILL = tank, AKILL = armored personnel carrier, VKILL = vehicles.</p>
F	<p>IDTBL = : Item codes of air defense weapon, ammunition pairs.</p>
G	<p>SUMTBL = : Entry contains the sum of air defense weapons by type, contained by units in the list of descriptor I.</p>
H	<p>AMOTBL = : Entry contains the sum of air defense weapon ammunition by type, contained by units in the list of descriptor I below.</p>

ENTERING TORA
TGT = 035
EST ACTVY = 21
MT = 41

(A) JZONE = 3
PRIORITY = 1
INDEX = 7
AC = 2.0000
AF = 2.0000
PCNTTG = .993127
TAF = 1.98625

(B) FRIENDLY RESULTS

(C)

(D) TAF = 1.98625
ENEMY RESULTS

0.0000
.0296
.0636
0.0000
0.0000
.0017
2.4232
3.3753
0.0000
0.0000
0.0000
17.9955

Figure IV-10-C-4. Engagement Results Printed Output from Air Ground Engagement Model (Continued on Next Page)

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Figure IV-10-C-4. Engagement Results Printed Output from Air Ground Engagement Model (Concluded)

Output
Descriptor

Explanation

- I Each two lines of this entry represents one air defense weapon-ammunition pair. The first word of each line is the IUID of the air defense unit. The second word of the first line is the item code of the air defense weapon, the second word of the second line is the item code of the ammunition for this weapon. The third word of line one is the total number of air defense weapons of this type remaining after the losses are subtracted; the third word of line two is the total amount of ammunition remaining for this weapon type after losses are subtracted. There are two lines printed for each air defense weapon type in each air defense unit.
- J The first word in this entry is the aircraft type flying the mission. The second word in this entry is the aircraft item code. The third word is the number of aircraft remaining after subtracting losses due to the engagement.
- K This entry gives the present personnel strength of the mission unit.
- L The first word of this entry is amount of fuel consumed per hour. The second word is the amount of fuel used during the attack.
- FUEL CNSMP X: X is the amount of fuel used during attack, and should be the same figure appearing in the line above.
- REMAINING FUEL = X: This figure represents the amount of fuel belonging to the mission unit after losses have been subtracted. Losses include fuel consumed during the attack and fuel lost due to aircraft losses.
- M MUN TYPE I : The munition type used by the aircraft
EOH I : The item code of the munition used.
AMNT X : The amount of munitions remaining after the attack.

The above three entries are repeated for each munition type.

5. SAFE POINT UPDATE - ROUTINE BTF. This segment of prints lists fuel consumption to the safe point. There will be one set of print statements from this segment for each time the aircraft reach the safe point, twice for each complete mission. The format is the same regardless of the mission type, and is illustrated in Figure IV-10-C-5. The first line of the printout has been explained in paragraph 1. The second and third lines indicate the IUID of the mission unit and the fuel consumed by the mission unit. The amount of fuel remaining is that amount in the mission unit's supply after fuel consumed has been subtracted, and appears in routine BTF.


```

AIR                2
IUIDMU = 302
FUEL CONSUMED TO REACH FEBA = 11.007
FUEL REMAINING = 150.993

```

Figure IV-10-C-5. Safe Point Update Printed Output from Air Ground Engagement Model

6. MISSION END - ROUTINE BTA. This segment handles all mission end activity. The print statements list all information regarding returning aircraft. This segment is called only at the end of a complete mission. The format is the same regardless of the mission type, and is illustrated in Figure IV-10-C-6. The descriptors in the figure are explained as follows:

<u>Output Descriptor</u>	<u>Explanation</u>
A	<p>This entry is printed at the end of each mission. Landing time required and time aircraft will be available for another mission, for both returning and recoverable aircraft, are computed.</p> <p>BTA I : Routine BTA has been called. This statement appears in routine BTA.</p> <p>TARGET = I : IUID of the target. This statement appears in routine SEG5.</p> <p>MISSION UNIT = I : IUID of the mission unit. This statement appears in routine SEG5.</p> <p>BKILLS = X : Number of B-kills suffered during mission. This statement appears in routine SEG5.</p> <p>CKILLS = X : Number of C-kills suffered during mission. This statement appears in routine SEG5.</p> <p>DKILLS = X : Number of D-kills suffered during mission. This statement appears in routine SEG5.</p> <p>WEATHER = I : Routine WETTHR is called to get the weather code. This statement appears in routine WETTHR.</p> <p>LANDT = I : Time needed to land all aircraft at the airbase. This number is a function of the number of aircraft and weather. This statement appears in routine SEG5.</p> <p>UNDMAG = X : The total undamaged aircraft returning from an air mission. This statement appears in routine SEG5.</p> <p>ITUK = I : The amount of time in centiminutes before the undamaged aircraft can be restored to the airbase supply available for reassignment. This statement appears in routine SEG5.</p>
B	<p>This entry is printed when the aircraft are being restored to the airbase.</p>

A	AIR	7			
	BTA	8			
	TARGET =	806			
	MISSION UNIT =	300			
	BKILLS =	0.000			
	CKILLS =	0.000			
	DKILLS =	0.000			
	WEATHER =	0			
	LANDT =	1000			
	UNDMAG =	1.962			
	ITUK =	1500			
B	AIR	11			
	BTA	12			
		199	298	0	0
		88	2.000	3.903	
		98	0.000	3.000	
		85	20.000	0.000	
		86	20.000	0.000	
		87	0.000	0.000	
		91	0.000	0.000	
		99	0.000	3.000	
		0	0.000	0.000	
		0	0.000	0.000	
		90	184.000	8.000	
		7	7000.000	500.000	
		0	0.000	3.000	
		0	0.000	0.000	
		0	0.000	0.000	
		0	0.000	0.000	
		3	9161.900	0.000	

Figure IV-10-C-6. Mission End Printed Output from
Air Ground Engagement Model

Output
Descriptor

Explanation

BTA I : Routine BTA has been called. I is INCOPR. The next four entries (line 3) are the IUID of the airbase, IUID of the mission unit, and coordinates of the mission unit. The mission unit is being restored; therefore, the coordinates are zero. This statement appears in routine BTA.

The remaining entries are repeated one line per equipment type. Each line includes the equipment code of the item to be restored, the amount of the item the airbase has on hand, and the amount to be restored by the mission unit. This statement appears in routine BTA.

The following are print statements that can appear in this segment but are not shown in the examples of the printed output:

NO RESTORATIONS BEING MADE: When there are no undamaged aircraft remaining in the mission unit this message is printed. The message means there are no aircraft immediately available to be restored to the airbase. Remaining fuel and personnel and, in the case of attack helicopters, munitions are restored to the airbase.

ITBK I : The amount of time in centiminutes before aircraft sustaining B-kills can be restored.

ITCK I : The amount of time in centiminutes before aircraft sustaining C-kills can be restored.

ITDK I : The amount of time in centiminutes before aircraft sustaining D-kills can be restored.

APPENDIX D

SOURCE LISTINGS FOR PERIOD PROCESSOR AIR GROUND ENGAGEMENT MODEL

(AVAILABLE UNDER SEPARATE COVER)

IV-10-D-1

APPENDIX E

REFERENCES

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CHAPTER 11

SUPPRESSION MODEL

1. INTRODUCTION. The Suppression Model provides the DIVWAG system with the capability of simulating the disruptive effect of enemy fire upon a unit engaged in movement, indirect fire, or air defense fire activities. Units engaged in ground combat (i.e., attacking, defending, or withdrawing) are not subject to the effects of this Suppression Model.

2. SUPPRESSION OF MOVEMENT. The suppression of ordered movement is accomplished by halting the unit's movement for the duration of the suppression time indicated by the tables and then allowing the Movement Model to resume execution of the unit's move order.

a. The cessation of the unit's movement is achieved by determining the fractional part of the model move segment the unit will have traveled at the time the unit is engaged by fire and by stimulating the Movement Model to update the unit's fuel consumption and coordinates to that point. The suppression tables are interrogated, and the unit remains stationary for the amount of time selected from the tables. The time that a unit will remain stationary will be extended if, before its expiration, the unit is struck by additional fire with an associated suppression time greater than the remaining time of the preceding suppression.

b. When the suppression is completed, the Movement Model is allowed to continue simulation of the unit's movement.

3. SUPPRESSION OF INDIRECT FIRE. The simulation of suppression of fire of indirect fire units is a time delay added to the time associated with the delivery of each round or volley. Fire delivery time is the time that elapses from the receipt of the fire order to the impact of the round or rounds. The suppression of indirect fire is simulated by extending this fire delivery time by a suppression time selected from the suppression time tables. The Suppression Model contains logic that allows it to determine if fire received by the unit overlaps or partially overlaps the suppression time assessed by a preceding fire event and to extend the suppression time if appropriate. A unit not firing at the time enemy fire is received cannot be given an order to fire until its suppression time has elapsed.

4. SUPPRESSION OF AIR DEFENSE FIRE. Among the activities simulated by the ground-to-air attrition routine are air defense fires and suppression of such fires. The ground-to-air attrition routine extracts the suppression times required from the suppression time tables described in Appendix A to this chapter. The tabular values selected and the game time at which the unit last received fire are used to determine whether the air defense weapons of a unit are suppressed for any fraction of the air attrition time interval being simulated. Note that a unit executing a move or indirect fire order may have that activity interrupted for a different length of time than its air defense weapons are suppressed.

5. INTERFACES WITH OTHER MODELS. The Suppression Model is activated by the model initiating the fires (Area Fire or Air Ground Engagement). It in turn uses the Movement Model to terminate the unit's movement if necessary. The suppression time tables are shared with the ground-to-air attrition routine.

APPENDIX A

SUPPRESSION MODEL INPUT REQUIREMENTS

1. INTRODUCTION. This appendix describes the data required by the Suppression Model. A unit engaged in an ordered movement, indirect fire, or air defense fire activity will sustain an interruption of activity if it receives enemy fire during the course of the activity. This appendix provides instructions for preparing the data necessary for the model to determine the duration of such interruptions.

a. Data File Relationships. The data files described in Chapter 3 must be loaded in the DIVWAG Model data base before the Suppression Model data can be loaded. It should be noted that if a change is made in the TOE files, the Suppression Model data must be reloaded.

b. Data Requirements. The purpose of data prepared for the Suppression Model is to provide the amount of time an activity will be suppressed subject to given circumstances. This time is a function of the type of unit fired upon, the activity at time fire is received, and the type of fire received. Two types of tables are required by the Suppression Model to associate the correct suppression time with a set of circumstances. The first of these is the suppression group table. This table allows unit types that react similarly to the various activity-fire type combinations to be grouped together. Grouping the unit types in this manner reduces the required number of tables of the second type. The tables required are tables of suppression times as a function of activity and as a function of type of fire. A suppression time table is required for each group that is defined.

c. Data Base Files. The suppression groups and suppression time tables required are stored on data file 8.

d. Data Needed. Data defining the suppression groups and the suppression time tables are required.

(1) Suppression Groups. All unit types engaging in movement or fire activities must be included in one--and only one--suppression group. The model assumes all units belonging to a particular group are suppressed for identical amounts of time under similar circumstances. This is the primary factor to be considered when suppression groups are being developed.

(2) Suppression Time Tables. A table of suppression times as a function of activity and type of fire received must be supplied for each suppression group that is defined. The form of this table is illustrated in Figure IV-11-A-1. The times required are in seconds.

Activity \ Type Fire	Type Fire		
	Artillery	TACAIR	DAFS
Movement			
Indirect Fire			
Air Defense Fire			

Figure IV-11-A-1. Suppression Time Table (Seconds)

2. ASSEMBLING THE DATA BASE. The following subparagraphs describe in detail the data required by the Suppression Model, and procedures for the entry of the data into the data base.

a. Suppression Group Table. As the suppression times are a function of unit type, the unit type designator (UTD) is used in defining the suppression groups. A maximum of 50 suppression groups may be defined. The format of the card used to load these tables (ID 0801) is illustrated in Figure IV-11-A-2.

(1) Card Type and Force Designator (Columns 1-2). The "1" preprinted in column 2 should not be changed. In column 2, a "B" is entered if the grouping is for Blue force unit types, and an "R" is entered if the grouping is for Red force unit types.

(2) Suppression Group Index (Columns 5-6). A numeric value (1-50) identifying the suppression group to which the unit types are assigned is entered in these columns. The value must be right justified.

(3) UTDs Composing the Group (Columns 9-42). The four-character UTDs of the unit types making up each suppression group are listed in these columns. If more than seven unit types are included in the group, they must be listed on other cards which also have columns 1-6 completed as was explained above.

b. Suppression Time Table. The data form (Card ID 0802) required to load the suppression time tables is illustrated in Figure IV-11-A-3. This form allows the suppression times to be input as a function of suppression group, activity, and type of fire.

(1) Card Type and Force Designator (Columns 1-2). Do not change the "1" preprinted in column 1. Place a "B" in column 2 if the table applies to the Blue force, or an "R" if it applies to the Red force.

SUPPRESSION TIME TABLE																									
SUPPRESSION GROUP INDEX		SUPPRESSION TIME (IN SECONDS)																CARD NO.							
		MOVEMENT				DIRECT FIRE				BLANK	AIR DEFENSE FIRE				CARD ID										
		ARTY	TACAIR	DAYS	RESERVED	ARTY	TACAIR	DAYS	RESERVED		ARTY	TACAIR	DAYS	RESERVED											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21					

Figure IV-11-A-3. Suppression Time Table

(2) Suppression Group Index (Columns 5-6). This is the same index used on form 0801 to identify the various suppression groups. Placing an index in these columns links that suppression group to this suppression table. Again, the index must be right justified.

(3) Suppression Time - Movement/Artillery Fire (Columns 9-13). The amount of time a unit belonging to the indicated suppression group will have its movement delayed if it receives artillery fire is entered in these columns. The value must be right justified and is in seconds.

(4) Suppression Time - Movement/TACAIR Fire (Columns 14-18). The movement delay time (in seconds) of units of this suppression group that are subjected to tactical aircraft fires is entered in these columns.

(5) Suppression Time - Movement/DAFS (Columns 19-23). The movement delay time (in seconds) of units of this suppression group that are subjected to direct aerial fires is entered in these columns.

(6) Suppression Time - Indirect Fire/Various Fire Types (Columns 31-45). The activity suppression time (in seconds) of a unit belonging to the indicated suppression group and engaging in an indirect fire activity and which receives enemy fire from one of the various types indicated is entered in these fields.

(7) Suppression Time - Air Defense Fire/Various Fire Types (Columns 53-67). The activity suppression time (in seconds) of the air defense weapons of a unit belonging to the indicated suppression group and receiving fire from one of the types of enemy fire indicated is entered in these fields.

(8) Other Data. Only one card is required to describe a suppression time table. Columns 24-28, 46-50, and 68-72 are reserved for future data requirements of the model.

3. SUPPRESSION CONSTANT DATA DECK STRUCTURE. This paragraph describes the deck structure required by the Suppression Model constant data load program.

a. Suppression Constant Data Input Cards. The card types required by the Suppression Model are listed below.

<u>Card Type</u>	<u>Card Title</u>	<u>Card ID</u>	<u>Load Program Name</u>
1	Suppression Group Table	0801	SPRSLD
2	Suppression Time Table	0802	SPRSLD

b. Suppression Model Constant Data Deck Structure. The deck of input cards required to load the Suppression Model constant data file is divided into four distinct groups. These groups are depicted in the correct order in Figure IV-11-A-4.

(1) Card Groupings. The Suppression Model constant data load program requires the four groups of cards to be in a fixed order. The group order is Blue Force Suppression Group Tables; Red Force Suppression Group Tables; Blue Force Suppression Time Tables; and Red Force Suppression Time Tables. A card with the characters "END DATA" punched in columns 73-80 must immediately follow the Red Suppression Time tables as is shown in Figure IV-11-A-4. No particular order of cards within a group is required.

(2) Updating or Correcting the Data File. Changes to the Suppression Model constant data file are accomplished by reloading a corrected data deck.

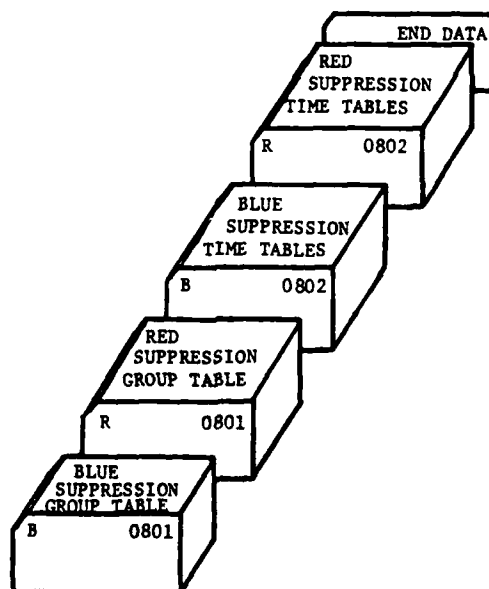


Figure IV-11-A-4. Suppression Model Data Deck Structure

APPENDIX B

SUPPRESSION MODEL PROGRAM DESCRIPTIONS

1. INTRODUCTION. This appendix contains the program description for routine SUPRES that handles suppression within the Suppression Model of the Period Processor.

2. ROUTINE SUPRES:

a. Purpose. This routine simulates suppression of moving or firing units resulting from artillery or aerial fires.

b. Input Variables:

(1) Standard Common Block Areas. UMAIN and TCLOCK.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IE	TWO	Event code of unit's current event.
IET	TWO	Time unit's current event expires.
SPTIME	DF28	Suppression time applying to this type of unit, activity, and fire.
JUID	DF12	IUID of unit receiving fire.
TFIRE	DF12	Code of type of fire being received: 1 = artillery, 2 = close air support, 3 = direct aerial fire support.

c. Output Variables:

(1) Standard Common Block Variables. LTASMT, SUPTIM, MEVTX and MEVTY.

(2) Other Variables.

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
IE	TWO	Event code of unit's current event.
IET	TWO	Time unit's current event terminates.

d. Logical Flow (Figure IV-11-B-1):

(1) Block L1100. Ground movement is suppressed. If the unit is not moving on the ground, control goes to block L2100.

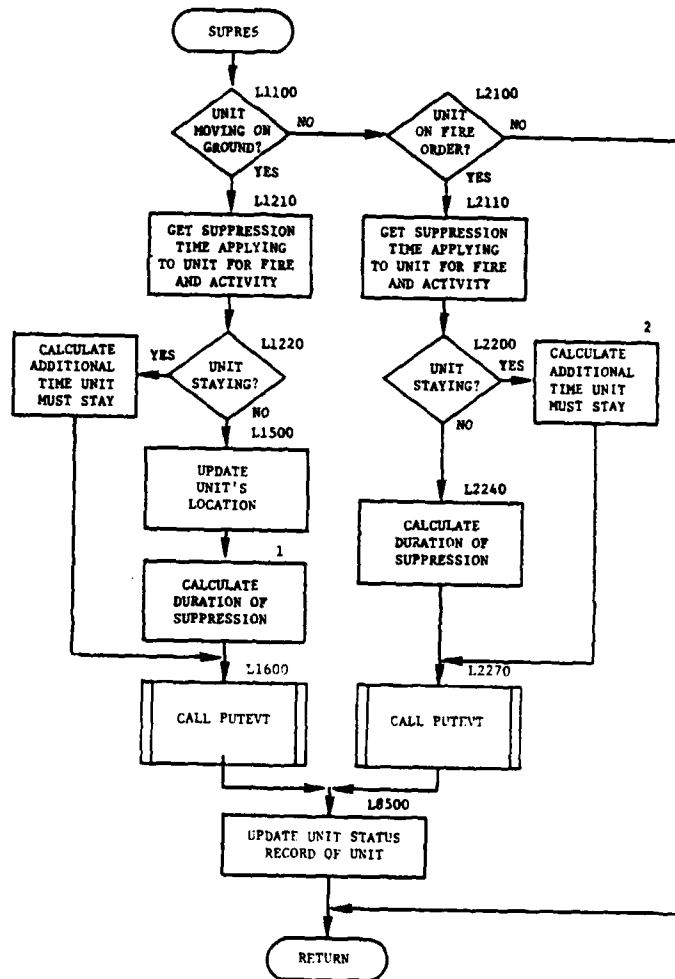


Figure IV-11-B-1. Routine SUPRES

IV-11-B-2

(2) Block L1210. A suppression time table is supplied as constant data for each suppression group. The pointer to the table applying to a particular unit is stored in the variable IREC8 of the unit's status record. Each tabular value is a function of unit activity and fire type. The type of fire (TFIRE) is passed to the routine on the second word of the data file 12 record used to initiate action of the suppression routine. The unit's activity is determined by the variable IE. This information is used to extract the proper suppression time (SPTIME) from data file 8.

(3) Block L1220. If the unit is in a stay event, its event code is one. If the suppression due to this type of fire causes the stay order to be extended beyond its present expiration time, the duration of the extension is calculated.

(4) Block L1500. Unit movement is modeled in discrete segments; therefore, it is necessary to update the unit's location and consumption of supplies to reflect its actual status at the time the fire hit. This is accomplished by calculating the fractional part of the segment the unit has traversed and, in turn, determining the correct coordinates (MEVTX and MEVTY) and calling MOVE to perform the unit relocation and supply consumption.

(5) Block 1. The activity is suppressed for the duration of time indicated by the tabular suppression time value. The amount of time the unit lost during the move (stored in MUNTYPY) is increased by the amount of time that movement is suppressed.

(6) Block L1600. Routine PUTEVT is used to set up a stay event of proper duration for this unit.

(7) Block L2100. If a unit is not on a fire order its activity will not be suppressed.

(8) Block L2110. See discussion of block L1210, paragraph d(2) above.

(9) Block L2200. If the unit's event code (IE) is equal to one, the unit is not in the process of firing. It will not be given an order to fire while it is suppressed.

(10) Block 2. If the suppression of fire due to this volley causes the stay event to be extended, the new termination time of the stay event is TCLOCK plus SPTIME.

(11) Block L2240. The suppression of a unit engaged in firing is accomplished by extending the time required to prepare to fire and to fire a volley. If the unit is currently suppressed by enemy fire, the suppression times will overlap. The duration of the extended time to fire (MODTM) is equal to SPTIME if there is no overlap. If there is overlap, MODTM is calculated by subtracting the quantity derived by adding the time the unit was last suppressed (LTASMT) to the amount of time it was to be suppressed (SUPTIM) and subtracting the current time (TCLOCK) from the suppression time (SPTIME) associated with this type of fire. If the value of MODTM calculated is negative, MODTM is set to zero to indicate the suppression

time associated with this fire elapses before the suppression time currently in effect ends, and no modification is made to the time required to fire.

(12) Block L2270. Routine PUTEVT is used to extend the termination time of the appropriate stay or fire event the unit is currently executing.

(13) Block L8500. The variables LTASMT and SUPTIM are updated and returned to data file 1.

APPENDIX C

SUPPRESSION MODEL OUTPUT DESCRIPTION

1. INTRODUCTION. This appendix contains a sample and detailed description of the printed output from routine SUPRES within the Suppression Model of the Period Processor. This output is described in the following paragraph.

2. ROUTINE SUPRES. Figure IV-11-C-1 presents the output of routine SUPRES which simulates suppression of movement or indirect firing in response to artillery or aerial fires. All output is keyed to print switch 3. The figure is explained as follows:

SUPRES	= routine SUPRES has been called.
IUID	= identification code of unit receiving fire.
EVENTC	= event code of unit's current activity.
NORD	= unit's pending order code.
TYPE FIRE	= code of type of fire being received; 1 = artillery, 2 = TACAIR, 3 = DAFS.
LASTASMT	= time the unit was last suppressed.
SUPRES TIME	= amount of time the unit will be suppressed.
LAST SUPRES TIME	= amount of time the unit was to be suppressed during the last suppression.
DELT	= time until suppression ends.

WALL CLOCK = 178 1 CPSEC = 1168.548 .958
 SUPRES-IUTD 118.EVENTC 1,NORD 10,TYPE FIRE 1, LASTASHT -1000101, SUPRES TIME 0, LAST SUPRES TIME 0, DELT 1500
 9 2538 3926
 381 29 61 4 1 0 19 273 39 52 0 0 0
 TIME = 21.43.02.

Figure IV-11-C-1. Routine SUPRES Sample Printed Output from Suppression Model

APPENDIX D

SOURCE LISTINGS FOR PERIOD PROCESSOR SUPPRESSION MODEL

(AVAILABLE UNDER SEPARATE COVER)

IV-11-D-1

CHAPTER 12

NUCLEAR ASSESSMENT MODEL

1. MILITARY ACTIVITY REPRESENTED:

a. The Nuclear Assessment Model assesses the effects of tactical nuclear weapons against personnel, materiel, and barriers and facilities. The magnitude of the energy released in a nuclear explosion exceeds enormously the energy released in a nonnuclear explosion. Transfer of energy from the weapon to the surrounding media begins with the actual nuclear explosion and is exhibited as three distinct effects:

(1) Blast. Mechanical shock effects are produced by a high-pressure impulse or wave as it travels outward from the burst.

(2) Thermal Radiation. Heating effects result as objects in the surrounding area absorb thermal energy released by the burst.

(3) Nuclear Radiation. Ionizing effects are produced when nuclear radiation emitted by the burst is absorbed.

b. Two specific types of information pertaining to the military use of nuclear weapons have been developed through weapon tests.

(1) The thermal, blast, or nuclear radiation levels required to cause a particular degree of damage to a materiel or a personnel target element.

(2) The distance to which the required levels will extend from a given weapon.

c. Although the Nuclear Assessment Model does not explicitly consider the discrete weapon effects, the use of test data provides for a reliable assessment of the combined effects of thermal, blast, and nuclear radiation within the validity factors associated with the data.

d. The actual delivery of tactical nuclear weapons requires targeting, scheduling, and laydown of weapons that cannot be simulated by the current DIVWAG system as an automatic feature in the same manner that nonnuclear fires are simulated. In tactical nuclear warfare, a potential nuclear target is analyzed for its composition; a desired level of damage is derived; a yield, height of burst, and ground zero for the nuclear weapon to produce the desired level of damage is determined; a delivery system is selected; troop safety limits are checked; and the weapon is scheduled and fired. Once the weapon is fired, the actual ground zero, yield, and height of burst are calculated, and the effects of the weapons on military targets are assessed. The Nuclear Assessment Model simulates only the latter activities.

e. In the play of a war game simulating high intensity conflict and utilizing the DIVWAG system, the military gamer must array forces on the battlefield according to appropriate doctrine for tactical nuclear warfare and must perform the necessary nuclear weapon targeting. Nuclear fires may then be integrated with the conventional war simulation to achieve the objectives of the game. In order to ensure optimum efficiency in using the DIVWAG system for play of tactical nuclear games, the game periods should be short compared to periods simulating the employment of conventional munitions. Without such relatively short periods, a simulation of the less dense, more porous, and highly mobile tactical nuclear battlefield may produce distorted and noncredible results.

2. MODEL DESIGN:

a. Model Structure. The Nuclear Assessment Model processes a nuclear fire event by independently considering the weapon effect against units, obstacles, facilities, and sensors within appropriate distances from ground zero. The assessment methodology is resolved into the following five phases: location of ground zero, assessment of units (personnel and equipment, including sensors), assessment of barriers and facilities, creation of an induced radiation hazard area, and scheduling of radiation assessment. The flow through the Nuclear Assessment Model is depicted in Figure IV-12-1.

(1) Location of Ground Zero:

(a) Requirements for a nuclear fire event include the specification of the x and y coordinates of the desired ground zero, the location of the fire unit, the delivery system to be employed, the desired warhead, the type of fuze desired, and the desired height of burst.

(b) Associated with each delivery system and fuze type is a table of expected delivery errors as a function of weapon-target range. From the range and deflection standard deviations the range and deflection errors are calculated using two normally distributed random numbers. The probable error in height of burst is used to determine the actual height of burst, again making use of a random number from a normal distribution. The round velocity is then used to make a further adjustment in the range error of the round. Range and deflection errors are resolved into x and y components to determine the actual ground coordinates under the burst. If a round impacts (actual height of burst goes to zero or negative) and the fuze does not provide for a detonation upon impact, the round is considered a dud.

(2) Assessment of Units:

(a) Combined effects damage radii corresponding to the actual height of burst are determined by interpolating among input height of burst values. The largest radius, centered at ground zero, determines the area of search for units to be assessed. If any portion of a unit is within this area it is assessed based upon the force composition. The following target categories are assessed using appropriate damage radii.

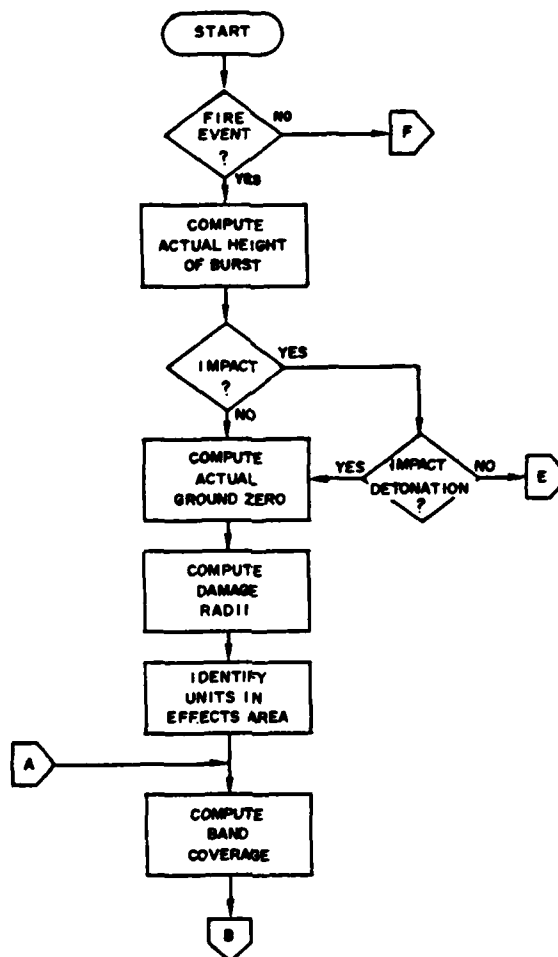


Figure IV-12-1. Nuclear Assessment Model Flow (Continued on Next Page)

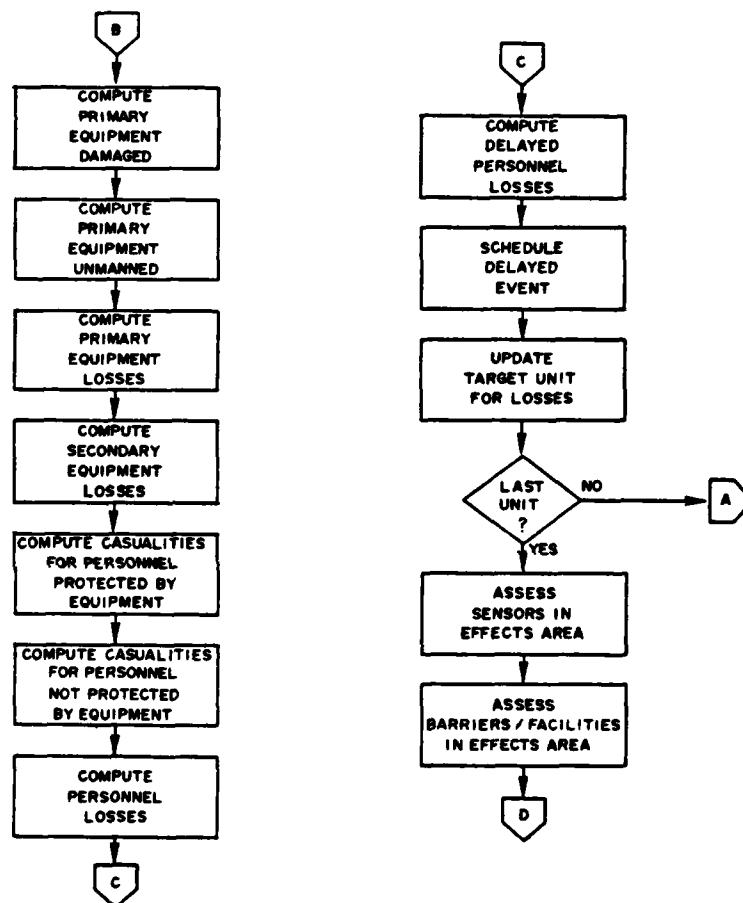


Figure IV-12-1. Nuclear Assessment Model Flow (Continued)

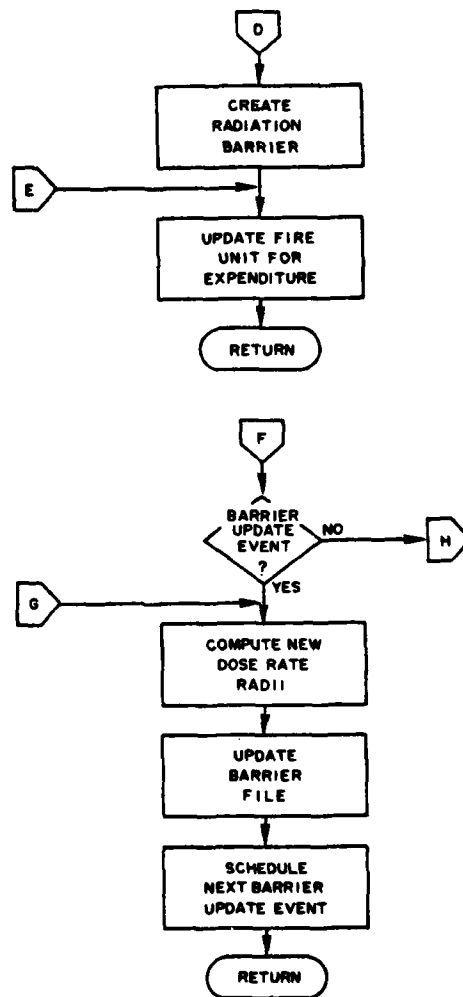


Figure IV-12-1. Nuclear Assessment Model Flow (Continued)

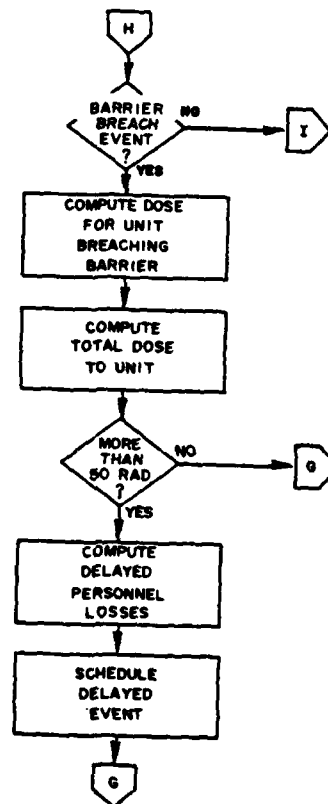


Figure IV-12-1. Nuclear Assessment Model Flow (Continued)

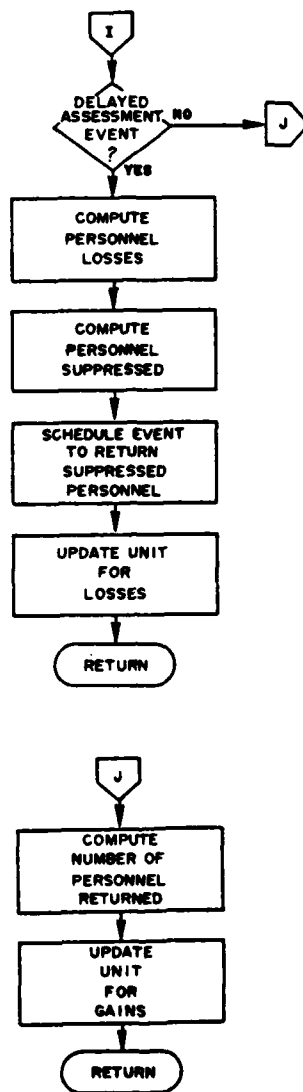


Figure IV-12-1. Nuclear Assessment Model Flow (Concluded)

1. Exposed personnel, prompt casualties.
2. Personnel in open foxholes, prompt casualties.
3. Personnel in earth shelters, prompt casualties.
4. Personnel in APCs, prompt casualties.
5. Personnel in tanks, prompt casualties.
6. Aircraft in flight (up to four types).
7. Equipment on the ground (up to six types).

(b) Equipment of each type to be assessed has its item code linked to one of the damage radii. For each equipment type the appropriate damage circle is centered at ground zero and the overlap area of the circle with each band of the unit being assessed is determined. All equipment of each type linked to the damage radius which is contained in the area of overlap between the uniformly distributed band and the circle is considered damaged. Personnel losses are accumulated by considering the casualties per equipment item summed over all equipment losses of each type.

(c) Personnel protected by tanks, APCs, and other equipment items affording similar protection are assessed for prompt radiation when the equipment items are located outside the blast damage circle but inside the radiation damage circle for protected personnel (tanks and APCs). Prompt radiation damage circles, centered at actual ground zero, are overlayed on the unit being assessed; and casualties per equipment item are assessed for those equipment items located in the areas described. These casualties are added to the blast casualty total. This technique of assessment may leave some items of equipment unmanned. These items are identified as unmanned in a printout and are treated as equipment losses.

(d) Casualties are next assessed to unit personnel not protected by equipment. This category obviously includes all remaining personnel in the unit, which are assumed to be distributed among vulnerability postures based upon unit activity and a warned or unwarned condition. For the stay activity the distribution of personnel among postures is additionally assumed to be a function of the time spent in that activity. The following postures are considered by the model.

- . Exposed personnel in the open
- . Protected personnel in open foxholes
- . Protected personnel in covered earth shelters.

Personnel in each posture are assessed by overlaying the appropriate damage circle on each band of the unit. Casualties within each overlap area are added to the previous personnel casualty total.

(3) Assessment of Barriers and Facilities:

(a) As many as 10 different damage radii are available for barrier/facility assessment, where the barrier/facility mnemonic identifies the appropriate radius to be used. Damage radii are determined by considering the actual height of burst and interpolating among input values. The largest of these radii defines the barrier/facility circle of search. Each barrier/facility within the circle of search, centered at ground zero, is included in the assessment.

(b) Each bridge within the barrier/facility circle of search is assessed by determining the fraction of the bridge within the appropriate damage circle centered at ground zero. If more than half the bridge is contained in the circle it is considered damaged; otherwise, the bridge is considered not damaged. The barrier file is updated to reflect the assessment when damage occurs.

(c) Jungles, forests, undergrowth, towns, and minefields--when assessed--result in new types of barriers/facilities. If more than half a jungle, forest, or undergrowth is contained in the damage circle corresponding to forest fires or tree blowdown it is changed to a forest fire or tree blowdown, respectively. If it is contained in both circles of damage, that circle which contains more than the other dominates in the assessment. If both circles contain the same portion, a random number determines the result.

(d) In general, a fixed percentage of mines is detonated in that portion of a minefield covered by the appropriate circle of damage. Assessment of a minefield results in a new minefield with a reduced mine density.

(e) Towns may be reduced to rubble or burned, but the Nuclear Assessment Model does not distinguish between these outcomes. If more than one half the town is contained in the single damage circle corresponding to towns, it is considered damaged. Casualties are not accounted for by the model as a function of damage to the town.

(4) Creation of an Induced Radiation Hazard Area:

(a) As a function of the soil type, an induced radiation hazard area is defined as being centered at ground zero and extending to a distance at which the radiation 1 hour after burst is 2 rads per hour. This barrier is placed on the barrier/facility file with other information required in a decision to breach.

(b) The radiation barrier record indicates the ground zero coordinates, the radius corresponding to the 2-rads-per-hour radiation rate, the time of the blast, and two inner radii corresponding to moderate and emergency radiation levels which are expected to exist 1 hour after the blast. The criteria used in defining the inner radii are the following:

1. The moderate risk radius is the radius at which the dose rate expected 1 hour after burst is 20 rads per hour.

2. The emergency risk radius is the radius at which the dose rate expected 1 hour after burst is 50 rads per hour.

(5) Radiation Assessment Scheduling:

(a) Radiation assessment scheduling is a continuous process for those units receiving a radiation dose that is initialized with the unit's first exposure. The first exposure may be one of two types:

1. If any portion of a unit is contained in any of the circles of damage corresponding to delayed personnel casualties, that unit is scheduled for a future assessment due to the delayed effects of incident radiation. The number of personnel to be assessed is determined for each posture as is done in the unit assessment, and the assessment time is determined by a uniform random number between 1 and 4 hours from the time of blast. The following damage radii are considered:

- . Exposed personnel, delayed casualties.
- . Personnel in open foxholes, delayed casualties.
- . Personnel in earth shelters, delayed casualties.
- . Personnel in APCs, delayed casualties.
- . Personnel in tanks, delayed casualties.

2. If any portion of a unit lies within the circle defined by the 2-rads-per-hour radius of induced radiation, that unit is scheduled for a future assessment due to the effects of induced radiation. Such units may be within the circle due to their movement into the region or due to their failure to move out of the region following the blast. The assessment is scheduled for the time the unit is to leave the area or for 1 hour from the time of the last assessment, whichever occurs first.

(b) At the appropriate time the unit is assessed in one of two ways:

1. Personnel casualties and suppressions calculated at the time of blast are subtracted from the unit status file. A subsequent event for each unit is scheduled to return suppressed personnel to active status. The time of the subsequent event is determined by selecting a uniform random number between limiting times outlined in FM 101-31-1 (Reference 1).

2. Units in induced radiation areas are allowed to accumulate radiation doses. Every hour, or when the unit leaves the area, the three radiation circles defined on the barrier file are overlayed on the unit to determine the percentage of personnel receiving each of the dose levels. As soon as any portion of a unit accumulates a total dose in excess of 50 rads, that unit is scheduled a future assessment, at which time the appropriate number of personnel will be suppressed or subtracted from the unit status file. Numbers of suppressions, casualties, and the assessment time are again determined by selecting random numbers between limiting values outlined in FM 101-31-1 (Reference 1).

b. DIVWAG System Interface:

(1) DSL:

(a) A nuclear fire event is initiated with a DSL fire order of the following forms:

STAY UNTIL 010530.
FIRE ON 0139000-0242000
IMPACT RADIUS 200 MUNITION TYPE NZK3
NUMBER OF ROUNDS 1
HEIGHT OF BURST 3.

or:

STAY UNTIL 010530.
FIRE ON 0139000-0242000
IMPACT RADIUS 10 MUNITION TYPE DXY2
NUMBER OF ROUNDS 1.

(b) The first DSL fire order is interpreted as follows:

1. At the time of the fire order (e.g., 010530) the round is in state of readiness I (i.e., maximum readiness). The model will add appropriate delay time and flight time to determine when the round actually reaches ground zero.

2. The coordinates of desired ground zero (DGZ) are specified after FIRE ON (e.g., 0139000-0242000).

3. The desired height of burst for only those weapons which allow such a specification is entered in meters after IMPACT RADIUS (e.g., 200). If the weapon's fuze allows only preset height of burst options, the IMPACT RADIUS entry is ignored.

4. Following MUNITION TYPE are four characters (e.g., NZK3):

a. The first character must be N, which identifies the munition type as nuclear.

b. The second character identifies the munition-weapon system to be employed.

c. The third character specifies the fuze option.

d. The fourth character specifies the yield option.

5. The number of volleys modifier is not allowed in a nuclear fire order. The number following NUMBER OF ROUNDS must be 1.

6. HEIGHT OF BURST is an optional modifier which must be included in a fire order when the munition fuze allows only preset height of burst options. The modifier is not required when the fuze allows specification of the desired height of burst following IMPACT RADIUS. The number following HEIGHT OF BURST (e.g., 3) must be exactly as defined for the specific munition type in the data preparation.

(c) The second DSL fire order is used for atomic demolition munitions (ADM). It is interpreted as follows:

1. At the time of the fire order (e.g., 010530) the round is in state of readiness I. The model will add the appropriate delay time.

2. The coordinates of actual ground zero (AGZ) are specified after FIRE ON (e.g., 0139000-0242000).

3. The actual depth of burst is entered as a positive number after IMPACT RADIUS (e.g., 10, indicating that the weapon is buried at a depth of 10 meters).

4. Following MUNITION TYPE are four characters (e.g., DXY2):

a. The character D identifies the munition type as ADM.

b. The second character identifies the munition to be employed.

c. The third character specifies the fuze option.

d. The fourth character specifies the yield option.

5. The number following NUMBER OF ROUNDS must be 1.

6. The optional height of burst modifier cannot be used.

(2) Engineer Model:

(a) A part of the execution of the nuclear fire order is to request a search of the appropriate area for a list of obstacles/facilities to be assessed. The Engineer Model returns an array of storage locations of such obstacle/facility records.

(b) Each record is examined individually to determine if the corresponding obstacle/facility is affected by the nuclear weapon's effects. If the obstacle/facility is destroyed the appropriate word in the record is changed to reflect the destruction, and the record is replaced. If the obstacle/facility is changed (e.g., tree blowdown) the appropriate word in the record is changed to reflect the destruction of the original obstacle/facility and a new record is created to establish the existence of a new obstacle. If an obstacle is created (e.g., induced radiation area) a new record is created to establish its existence and provided to the obstacle/facility file.

(3) Ground Combat Model. A nuclear fire event is scheduled such that ground combat is interrupted. The weapon is fired as scheduled, casualties are assessed, and ground combat continues.

(4) Intelligence and Control Model. During the search for units to assess, a search is also made for sensor locations. Each sensor is assessed by using the equipment damage radius associated with the item code index.

(5) Movement Model:

(a) If during a move event a unit encounters an induced radiation barrier a decision must be made as to whether the unit should attempt to cross. Parameters available to aid in such a determination are the following:

1. Actual ground zero.
2. Time of last barrier decay update.
3. Three dosage rate radii which will exist 1 hour following the last barrier decay update:

. 2	}	rads per hour.
. 20		
. 50		

4. Unit radiation history record.

5. Unit safety level.

(b) The unit safety level is a new parameter to be carried on the unit status file. There are three allowable levels of troop safety.

1. Negligible. Personnel in a unit with a negligible risk level should not attempt to enter a radiation hazard area if the duration of their activities in the area will result in a total dose greater than 50 rads. Such troops are completely safe from militarily significant effects. Negligible risk should not be exceeded unless significant advantage will be gained.

2. Moderate. A moderate risk from exposure to nuclear radiation occurs when either an individual or a unit has a significant radiation exposure history, but has not yet shown signs of radiation sickness, or when a contemplated single dose is sufficiently high that exposure, in conjunction with previous exposures, would constitute a significant radiation exposure history. Personnel in a unit with a moderate risk level should not attempt to enter a radiation hazard area if the duration of their activities in the area will result in a total dose greater than 200 rads. A moderate risk should not be exceeded if troops are expected to operate at full efficiency after exposure.

3. Emergency. For emergency risk conditions the anticipated effect on troops may be a few casualties; however, casualties should never be extensive enough to neutralize a unit. An emergency risk from exposure to nuclear radiation occurs when a planned single dose, in conjunction with previous exposures, would exceed or approach the threshold for combat ineffectiveness. Personnel in a unit with an emergency risk level should not attempt to enter a radiation hazard area if the duration of their activities in the area will result in a total dose greater than 500 rads. An emergency risk should be accepted only when absolutely necessary.

(c) A decision as to action to occur as a result of the encounter is simulated in the Movement Model.

3. SUBMODEL SPECIFICATIONS:

a. General. The five phases of the assessment methodology discussed in Model Design are treated by four major submodels within the Nuclear Assessment Model. Barrier/facility assessment and creation of induced radiation hazard areas are combined into a single submodel. Each of the other phases is treated by a distinct submodel.

b. Location of Ground Zero:

(1) General. In conventional artillery fires, weapon effects are obtained by firing many rounds and allowing the inherent delivery errors to place the rounds randomly throughout the target area. In nuclear fires, weapon effects are dependent on the delivery errors of a single round. Figure IV-12-2 illustrates the importance in nuclear fires of considering elliptical dispersion patterns as well as the fire unit's location relative to the target unit in assessing damage to a rectangular area. Depicted in this figure is the damage resulting from a detonation at the extreme edge of the dispersion pattern for identical weapon systems attacking a target from different directions. In Figure IV-12-2A the fire unit is located such that the largest component of the weapon system's aiming error is parallel to the smallest dimension of the target unit. In Figure IV-12-2B the fire unit is located such that the largest component of the weapon system's aiming error is parallel to the largest dimension of the target unit. The resulting damage differs for these cases by a factor of about 4.

(2) Horizontal Dispersion. Assuming an elliptical dispersion pattern, a conditional actual ground zero is calculated using the range and deflection standard deviations, the coordinates of desired ground zero, and the weapon and target locations.

(a) The range and deflection errors are determined by generating a normal deviate from a uniform deviate using the Hasting's approximation of Equation IV-12-1:

$$x = a \left\{ \eta - \left(\frac{2.515517 + 0.802853\eta + 0.010328\eta^2}{1 + 1.432788\eta + 0.189269\eta^2 + 0.001308\eta^3} \right) \right\} \quad (\text{IV-12-1})$$

where:

x is the normal deviate and η is given by Equation IV-12-2:

$$\eta = \sqrt{\ln (1 / (0.5 - q)^2)} \quad (\text{IV-12-2})$$

In Equation IV-12-2 q is a uniform random number between zero and one. The variable a in Equation IV-12-1 takes on the sign of $(0.5 - q)$.

(b) Two uniform random numbers are used to generate two normal deviates, X_r and X_d , corresponding to range and deflection. The errors in range and deflection, Δr and Δd , are found from Equation IV-12-3:

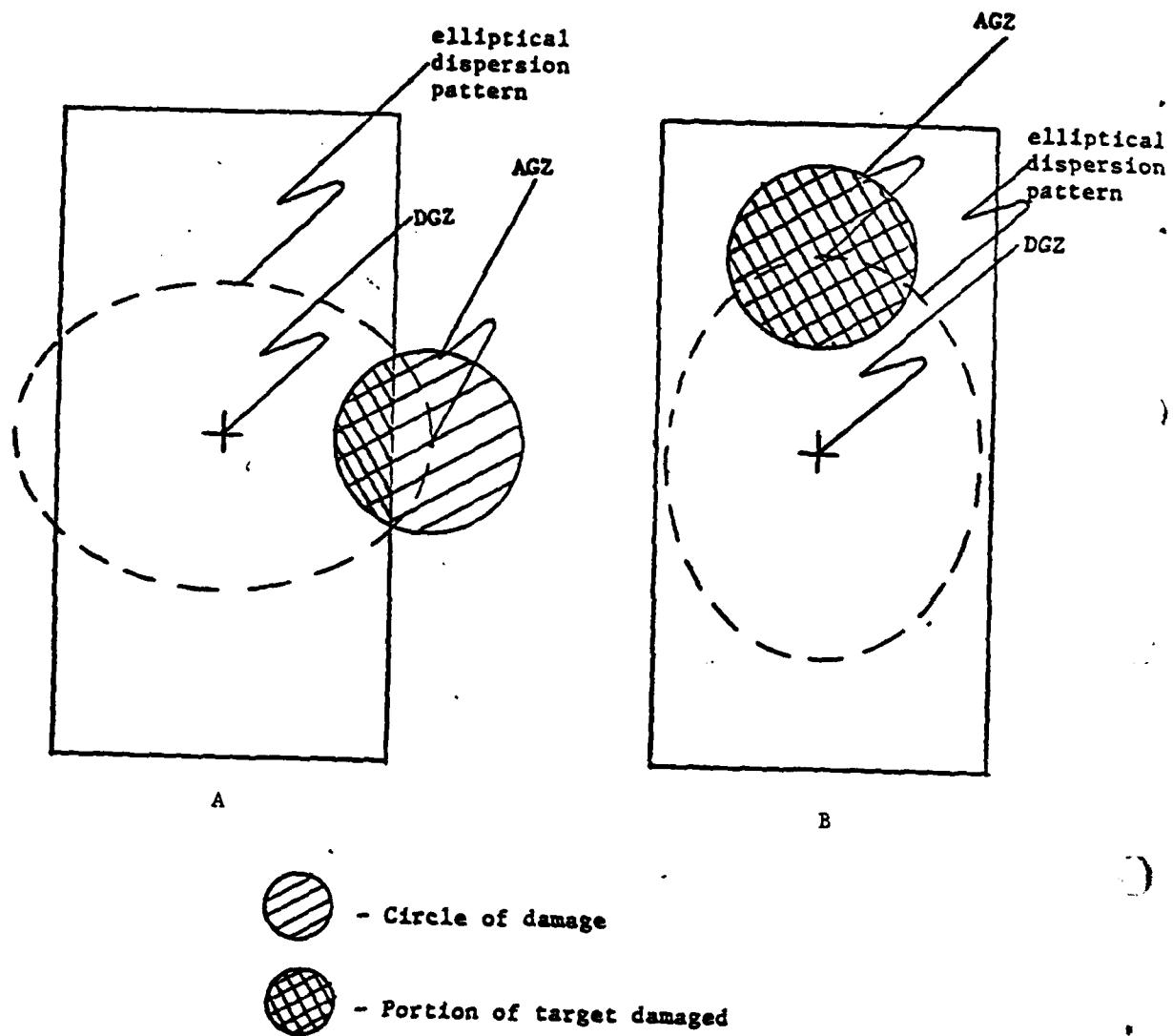


Figure IV-12-2. Effect of Elliptical Dispersion Pattern on Damage Assessment

$$\Delta r = \sigma_r x_r \quad (\text{IV-12-3a})$$

$$\Delta d = \sigma_d x_d \quad (\text{IV-12-3b})$$

where σ_r and σ_d are the range and deflection standard deviations associated with the weapon system.

(3) Vertical Dispersion. Using the desired height of burst, H_0 , and the height of burst standard deviation, σ_H , the actual height of burst H is calculated using Equation IV-12-4:

$$H = H_0 + \sigma_H x_H \quad (\text{IV-12-4})$$

where x_H is another solution of Equation IV-12-1 using a new random number.

(4) Range Error Modification. The horizontal delivery errors of Equation IV-12-3 are conditional on the error associated with the height of burst. Figure IV-12-3 depicts this dependence, which is limited to range. In this figure R' represents the detonation range, which includes the error Δr of Equation IV-12-3a. H_0 and H represent the desired and actual heights of burst, and θ is the angle of the incoming round. R is the actual detonation range and is related to R' by Equation IV-12-5:

$$R = R' + \delta r = R' - \frac{H - H_0}{\tan \theta} \quad (\text{IV-12-5})$$

(5) Determination of Actual Ground Zero. The total range error, ΔR , is found by summing Δr from Equation IV-12-3a and δr defined by Equation IV-12-5. Actual ground zero is resolved into x and y coordinates using Equation IV-12-6:

$$x = x_0 + \frac{\Delta R(x_0 - x') - \Delta d(y_0 - y')}{D} \quad (\text{IV-12-6a})$$

$$y = y_0 + \frac{\Delta R(y_0 - y') + \Delta d(x_0 - x')}{D} \quad (\text{IV-12-6b})$$

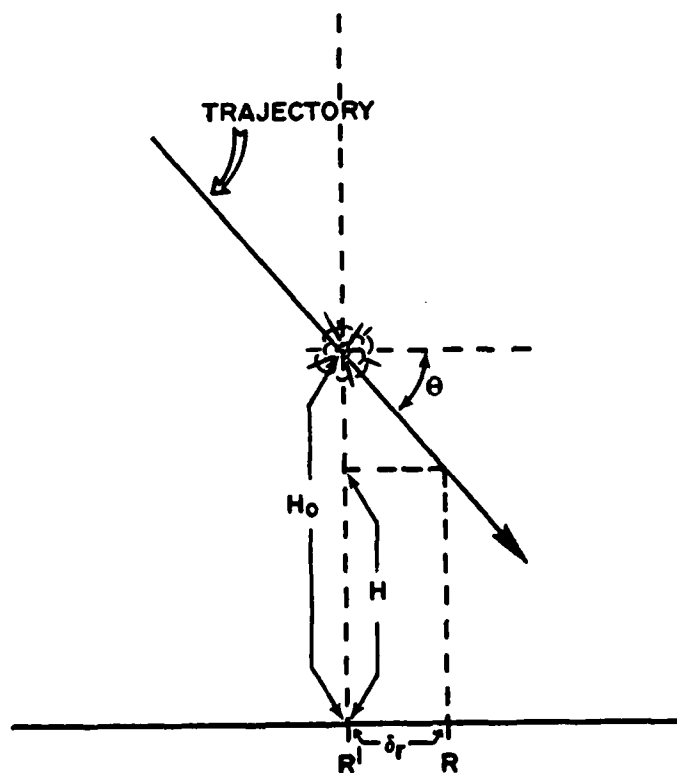


Figure IV-12-3. Effect of Error in Height of Burst on Error in Range

where x_0 , y_0 , and x' , y' are the coordinates of desired ground zero and the fire unit, respectively, and D is the horizontal distance from the fire unit to desired ground zero. Δd is defined in Equation IV-12-3b, and x , y are the coordinates of actual ground zero.

(6) Damage Radius Determination. After the actual height of burst, H , is determined by Equation IV-12-4 the damage radii are calculated before initiating the assessment process. Damage radii are input in the form of a radius of damage against each equipment type, each personnel posture, and each barrier/facility type for each desired yield at each of four heights of burst. The Nuclear Assessment Model assumes the nuclear weapon will function at the rated yield. The actual height of burst is then compared with the four input heights of burst for the specified yield for each damage category. If the actual height of burst falls within the range of input values a simple linear interpolation is used to determine the damage radius against each target category. If the actual height of burst falls outside the range of input values a linear extrapolation is used to determine the damage radius against each target category. If the actual height of burst is less than or equal to zero a check is made to see if the fuze specification allows for an impact detonation. If it does not the round is considered a dud, and there is no assessment.

c. Assessment of Units:

(1) General. The configuration of units and distribution of equipment and personnel within the unit bands, the distribution of protected and unprotected personnel, and the distribution of unprotected personnel among various postures are discussed in Chapters 5 and 8 of this section. The concept of all distributions presented therein applies to the Nuclear Assessment Model, although the numerical distributions may be different. The warned condition within the Nuclear Assessment Model implies receipt of a nuclear strike warning (STRIKWARN) message. The three postures for unprotected personnel are slightly different for the Nuclear Assessment Model as discussed in paragraph 2, and data are required for both a nuclear environment and a nonnuclear environment. The nuclear environment is assumed to commence immediately following the initial employment of nuclear weapons.

(2) Determination of Area in Common Between a Circle and Each Unit Band. This area in common is needed in the calculation of losses. The method of approximation outlined here is applied for each unit-oriented damage radius against each band of every friendly and enemy unit whose unit center is within the largest damage radius plus 4000 meters of actual ground zero. This method requires the coordinates of the unit center, the width and depth of the unit, the number of bands, the orientation angle of the unit, the coordinates of actual ground zero, and the radius of damage.

(a) Since each band of a unit is handled independently, it is necessary to define the length, width, and center point of each band. The definitions are as follows:

- . Length of band same as length of unit
- . Band width equals unit width divided by the number of bands
- . $XB = XU + \text{increment} * \cos \alpha$
- . $YB = YU + \text{increment} * \sin \alpha$

where:

XB, YB = coordinates of the center of the band
 XU, YU = coordinates of the center of the unit
 α = orientation angle of the unit

The increment is dependent upon N , the number of bands in the unit, and n , the band for which the center point is being found. The increments are as follows:

<u>N</u>	<u>n</u>	<u>Increment</u>
1	1	0
2	1	+ (band width / 2)
	2	- (band width / 2)
3	1	+ (band width)
	2	0
	3	- (band width)
4	1	+ (band width + band width / 2)
	2	+ (band width / 2)
	3	- (band width / 2)
	4	- (band width + band width / 2)

(b) The following steps are performed to approximate the area in common between the rectangle and the circle:

1. Divide the rectangle into a predetermined number ($IX * IY$) of smaller rectangles, each of the size ΔX by ΔY , where ΔX equals band width divided by IX and ΔY equals band depth divided by IY .

2. Calculate the coordinates, relative to the rectangle, of the lower left smaller rectangle ($X\phi, Y\phi$):

$$X\phi = 1/2 * (\Delta X - \text{band width}) \quad (\text{IV-12-7a})$$

$$Y\phi = 1/2 * (\Delta Y - \text{band depth}) \quad (\text{IV-12-7b})$$

(IX * IY number of iterations are made through the next three steps.)

3. Calculate the relative coordinates of each smaller rectangle (XP_i, YP_j) for $i = 1, IX$ and $j = 1, IY$:

$$XP_i = X\phi + \Delta X (i - 1) \quad (\text{IV-12-8a})$$

$$YP_j = Y\phi + \Delta Y (j - 1) \quad (\text{IV-12-8b})$$

4. Translate these relative coordinates into actual coordinates (XC_i, YC_j):

$$XC_i = XU + XP_i * \cos \alpha - YP_j * \sin \alpha \quad (\text{IV-12-9a})$$

$$YC_j = YU + YP_j * \cos \alpha + XP_i * \sin \alpha \quad (\text{IV-12-9a})$$

where:

XU, YU = coordinates of the band

α = orientation angle.

5. If the distance from this point to the center of the circle is less than the radius of the circle, the rectangle is included in the circle.

6. The approximation of the area in common is the total area of all smaller rectangles within the circle.

(3) Determination of Equipment Losses. Each equipment type item code which is to be included in the assessment is linked to one of the six available damage radii provided for assessment of primary equipment items. Each Red and Blue unit found to be in the damage area corresponding to the largest damage radius is assessed. The assessment involves determining the area in common between each damage radius and each band of the unit.

(a) Initial Primary Equipment. For each of the six damage radii (four damage radii, if the unit is in flight) a check is made to see if the unit has at least one equipment item which is to be assessed using the radius.

Only those radii which qualify are considered. Primary equipment losses are then calculated using Equation IV-12-10:

$$CAS_i^{(I)} = \sum_j N_i f_{ij} AREACOM_{ij} / A_j \quad (IV-12-10)$$

where:

- $CAS_i^{(I)}$ = equipment losses of type i
- N_i = equipment on hand of type i
- f_{ij} = percent of equipment type i in band j
- $AREACOM_{ij}$ = area in common between the damage radius against equipment type i and band j
- A_j = area of the jth band.

The sum in Equation IV-12-10 is over all bands in the unit.

(b) Additional Primary Equipment. Each equipment item identified as a tank or an APC or as an item which provides similar protection may also be included in an additional assessment. If the damage radius corresponding to prompt casualties for personnel in the equipment item is larger than the damage radius against the equipment item itself an additional assessment is made. The number of primary equipment items left unmanned as a result of the nuclear fire is calculated by Equation IV-12-11:

$$CAS_i^{(A)} = \sum_j N_i f_{ij} AREACOM'_{ij} / A_j \quad (IV-12-11)$$

where:

- $CAS_i^{(A)}$ = equipment of type i left unmanned
- $AREACOM'_{ij}$ = area in common between the damage radius against personnel in equipment type i and band j.

(c) Total Primary Equipment. The equipment losses calculated by Equation IV-12-11 differ from those calculated by Equation IV-12-10 in that the equipment is not actually destroyed. Such equipment, however, has been subjected to intense radiation and cannot be considered usable for an extended period of time; therefore, it is considered an equipment casualty. The Nuclear Assessment Model defines the total equipment losses of type i, CAS_i , as all equipment of type i which is destroyed or not usable by Equation IV-12-12:

$$CAS_i = CAS_i^{(I)} + CAS_i^{(A)} \quad (IV-12-12)$$

The value of $CAS_i^{(A)}$ as well as the location of such equipment is provided in the Period Processor output with future retrieval left to gamer discretion.

(d) Secondary Equipment. Once the primary items have been assessed, the secondary losses are computed from the secondary equipment tables using Equation IV-12-13:

$$CAS_k = \sum_i CAS_i d_{ik} E_k / N_k \quad (IV-12-13)$$

where:

CAS_k = losses of secondary equipment item k

CAS_i = losses of primary equipment item i

d_{ik} = number of secondary items k authorized to primary item i

E_k = secondary item k on hand in unit

N_k = secondary item k authorized in unit.

(4) Determination of Prompt Personnel Losses. Personnel casualties are determined by a two-step process involving different categories of protection. Included in the assessment are personnel protected by equipment items which are destroyed, personnel protected by equipment items which are not destroyed but offer insufficient protection against the incident radiation, and personnel which are not protected by equipment items.

(a) Personnel Protected by Equipment. The number of personnel lost when the equipment providing protection is lost or left unmanned is calculated by Equation IV-12-14:

$$C_p = \sum_i n_i CAS_i \quad (IV-12-14)$$

where:

C_p = number of protected personnel casualties

n_i = casualties per equipment item type i.

(b) Personnel Not Protected by Equipment. The number of unprotected personnel in the unit is calculated using Equation IV-12-15:

$$N_u = N - \sum_i E_i m_i \quad (\text{IV-12-15})$$

where:

N_u = number of unprotected personnel
 E_i = equipment type i on hand in unit
 m_i = personnel protected per equipment type i
 N = present strength of the unit.

If N_u is greater than zero the number of unprotected personnel casualties is determined by Equation IV-12-16:

$$C_u = \sum_h \sum_j N_u f_j p_h \text{AREACOM}_{hj} / A_j \quad (\text{IV-12-16})$$

where:

C_u = number of unprotected personnel casualties
 f_j = percent of personnel in band j
 p_h = percent of personnel in posture h
 AREACOM_{hj} = area in common between damage radius against personnel in posture h and band j

(c) Total Casualties. The total personnel casualties, C, is calculated by Equation IV-12-17:

$$C = C_p + C_u \quad (\text{IV-12-17})$$

d. Assessment of Barriers/Facilities. The barrier/facility assessment is a two-step process involving the destruction of existing barriers and/or facilities and the creation of an induced radiation barrier.

(1) Assessment of Existing Barriers/Facilities. The largest damage radius applicable to barriers/facilities is used to perform a search for candidates for assessment. The assessment methodology is based on the

concept of the damage circle covering more than half the barrier/facility. Within the DIVWAG system, barriers and facilities are maintained as line segments. Determination of the 50 percent containment is accomplished by artificially giving the line segment a width of 1 meter to make it compatible with the existing circle/rectangle methodology. The fraction of the line segment contained in the circle can then be expressed by Equation IV-12-18:

$$F = \text{AREACOM}/L \quad (\text{IV-12-18})$$

where:

F = the fraction of the line segment within the circle

AREACOM = area in common between the 1-meter-wide rectangle and the circle

L = the length of the line segment (L carries the units of an area: $L = (Lm) * (1m) = Lm^2$)

(a) Bridges. If F is greater than one half, the bridge is destroyed.

(b) Towns. If F is greater than one half, the town is destroyed.

(c) Jungles, Forests, Undergrowth. Separate values are calculated for fires (F_f) and blowdown (F_b) if such radii are provided.

1. If F_f is greater than one half and F_b is less than one half, the forest is burned.

2. If F_f is less than one half and F_b is greater than one half, the forest is blown down.

3. If both are greater than one half and F_f is greater than F_b , the forest is burned.

4. If both are greater than one half and F_f is less than F_b , the forest is blown down.

5. If both are greater than one half and F_f is equal to F_b , a random number decides the resulting damage. If the number is greater than one half, the forest is burned; otherwise, it is blown down.

(d) Minefields. If F is greater than one half, the minefield density is reduced one level. Minefield density levels are discussed in Chapter 14.

(2) Creation of Induced Radiation Barriers. An area of induced radiation remains centered at ground zero following a nuclear detonation. Information regarding the area is placed on the barrier file to prevent troop movement through the area. The Nuclear Assessment Model provides three radii corresponding to negligible, moderate, and emergency nuclear radiation risk levels to troops. The radiation rates corresponding to these levels are 2 rads per hour, 20 rads per hour, and 50 rads per hour respectively. Also provided is the future time at which these radiation rates are projected to exist. Data from TM 23-200 (Reference 3) indicate that the radiation rate 1 hour after blast can be approximately related to the slant range by Equation IV-12-19:

$$\text{Rate} \cong a e^{-br} \quad (\text{IV-12-19})$$

where:

Rate = radiation rate (rads per hour) 1 hour after blast

r = slant range

a, b = parameters dependent on soil type and yield.

(a) Equation IV-12-19 can be solved for r for each of the three desired rates using Equation IV-12-20:

$$r_i = -\frac{1}{b} \ln\left(\frac{\text{Rate}_i}{a}\right) \quad (\text{IV-12-20})$$

where:

$$\left. \begin{array}{l} \text{Rate}_1 = 2 \\ \text{Rate}_2 = 20 \\ \text{Rate}_3 = 50 \end{array} \right\} \text{ rads per hour.}$$

(b) The ground ranges, R_i , corresponding to the slant ranges, r_i , of Equation IV-12-20 are found using Equation IV-12-21:

$$R_i = \sqrt{r_i^2 - H^2} \quad (\text{IV-12-21})$$

where H was defined in Equation IV-12-4.

e. Radiation Assessment and Scheduling:

(1) General. The Nuclear Assessment Model provides for three phases of radiation assessment and scheduling. Included in the assessment are those delayed casualties and/or suppressions resulting from the incident radiation, casualties and/or suppressions resulting from a unit's movement through an induced radiation barrier, and continuous updating of the radiation barrier size as it decays.

(2) Delayed Casualties. From FM 101-31-1 (Reference 1) the existing damage radii for delayed personnel casualties are based on a dose of 650 rads. The biological response to such a dose as well as other doses is provided in Figure IV-12-4. All radiation assessment methodology is based on data in this table.

(a) At the time of the fire event the percent of personnel within the unit which will become casualties and/or be suppressed is determined using Equation IV-12-22:

$$C_d = \frac{1}{N} \left(\sum_h \sum_j N_u f_j P_h (\text{AREACOM}'_{hj} - \text{AREACOM}_{hj}) / A_j \right) + \sum_j N_i f_{ij} (\text{AREACOM}'_{ij} - \text{AREACOM}_{ij}) / A_j \quad (\text{IV-12-22})$$

where:

- C_d = percent of unit which will become casualties and/or be suppressed
- N = present strength of unit
- N_u = number of unprotected personnel (Equation IV-12-15)
- f_j = percent of personnel in band j
- P_h = percent of personnel in posture h
- $\text{AREACOM}'_{hj}$ = area in common between damage circle for delayed casualties to personnel in posture h and band j
- AREACOM_{hj} = area in common between damage circle for prompt casualties to personnel in posture h and band j
- A_j = area of band j

Biological Response to Nuclear Radiation.

Estimated exposure range (rads)	Initial symptoms	Onset of symptoms	Incapacitation	Hospitalization	Duration of hospitalization	Final disposition
50 to 200 —	None to transient mild headache.	Approximately 6 hours after exposure.	None to slight decrease in ability to conduct normal duties.	Hospitalization required for less than 5 percent in upper part of exposure range.	45 to 60 days in upper part of range.	Duty. No deaths anticipated.
200 to 500 —	Headaches, nausea, and vomiting; malaise. Symptoms not relieved by antimitotics in upper part of exposure range.	Approximately 4 to 6 hours after exposure.	Can perform routine tasks. Sustained combat or comparable activities hampered for period of 6 to 20 hours.	Hospitalization required for 90 percent of exposed personnel in this range. Hospitalization follows latent period of 17 to 21 days' duration.	60 to 90 days —	Some deaths anticipated; probably less than 5 percent at lower part of range, increasing toward upper end.
500 to 1,000 —	Severe and prolonged nausea and vomiting; difficult to cure. Diarrhea and fever early in upper part of exposure range.	Approximately 1 to 4 hours after exposure.	Can perform only simple, routine tasks. Significant incapacitation in upper part of exposure range; lasts more than 24 hours.	Hospitalization required for 100 percent of exposed personnel. Latent period short, 7 to 10 days in lower range to none in upper range.	90 to 120 days — for those surviving.	Approximately 60-percent deaths at lower part of range, increasing toward upper end; all deaths occurring within 45 days.
Greater than 1,000.	Severe vomiting, diarrhea, and prostration.	Less than 1 hour after exposure.	Progressive incapacitation, following an early capability for intermittent heroic response.	Hospitalization required for 100 percent of exposed personnel. No latent period.	3 to 30 days —	100-percent deaths occurring within 30 days.

Figure IV-12-4. Biological Response to Nuclear Radiation (Reference 1)

N_i = equipment type i on hand
 f_{ij} = percent of equipment type i in band j
 $AREACOM'_{ij}$ = area in common between damage circle for delayed casualties to personnel in equipment type i and band j
 $AREACOM_{ij}$ = area in common between damage circle for prompt casualties to personnel in equipment type i and band j

(b) From Figure IV-12-4 the onset of symptoms due to a 650-rad dose is expected to occur from 1 to 4 hours after exposure. A uniform random number between 60 and 240 is used to determine the number of minutes after the blast at which casualties are expected to occur. For this dose the table indicates approximately 50 percent deaths, with more than a 24-hour period of incapacitation. An assessment record is maintained carrying this information, and a future assessment event is scheduled.

(c) At the time of the future assessment, C_d from Equation IV-12-22 is applied to the present strength of the unit. Fifty percent of the resulting number of personnel are considered casualties, remaining personnel being suppressed. Another event is scheduled for 24 hours from the current time.

(d) At the time of the last assessment $0.5 C_d$ is applied to the present strength to determine the number of suppressed personnel returning to active status.

(3) Radiation Barrier Assessment. Whenever a unit encounters a radiation barrier the Nuclear Assessment Model calculates the dose received by that unit and schedules an assessment event if appropriate. Stationary units are given accumulated doses every hour for as long as they remain in the area. Moving units are given a dose corresponding to the time to cross the barrier. Unit radiation dose histories are maintained for every unit which encounters a radiation area.

(a) Dose rates are determined by overlaying the three barrier radii discussed above on the unit. Personnel in each band which are in the area in common between the band and the 2-rads-per-hour radius and not in the area in common with the 20-rads-per-hour radius are given a dose rate of 10 rads per hour. Personnel in each band in the area in common with the 20-rads-per-hour radius and not in the area in common with the 50-rads-per-hour radius are given a dose rate of 35 rads per hour. Personnel in each band in the area in common with the 50-rads-per-hour radius are given a dose rate given by Equation IV-12-23:

$$\text{Rate} = \frac{1}{2} \left(50 + a e^{-bH} \right) \quad (\text{IV-12-23})$$

where the second term in parentheses is Equation IV-12-19 evaluated at ground zero.

(b) Total hourly doses for stationary units are determined by giving the fraction of personnel in the unit receiving each of the three dose rates a dose corresponding to each rate multiplied by 1 hour. The percentage of personnel in the unit receiving each of the three doses is maintained in a history record for possible future accumulation of additional doses.

(c) Total doses for moving units are determined by calculating the areas in common at the time when ground zero is colinear with the unit's leading edge as depicted in Figure IV-12-5. In this figure d_1 , d_2 , and d_3 are the chords to the 2-rads-per-hour, 20-rads-per-hour, and 50-rads-per-hour circles midway between the circle's radius and the radius of the next smaller circle (or the unit's edge). Dose rates of 10 rads per hour, 35 rads per hour, and the rate given by Equation IV-12-23 are given to those personnel in the areas labeled A_{10} , A_{35} , and A_{50+} . The time to cross through each of the areas is determined by Equation IV-12-24:

$$t_i = d_i/v \quad (\text{IV-12-24})$$

where v is the unit velocity. The percentage of personnel in the unit receiving each of the three doses is maintained as for stationary units.

(d) Doses are accumulated for all units using Equations IV-12-25:

$$d_1 = d_{1i} + d_{1c} \quad (\text{IV-12-25a})$$

$$d_2 = d_{2i} + d_{2c} \quad (\text{IV-12-25b})$$

$$d_3 = d_{3i} + d_{3c} \quad (\text{IV-12-25c})$$

$$\begin{aligned} P_1 = & P_{1i} (1 - \sum_k P_{kc}) + P_{1c} (1 - \sum_k P_{ki}) \\ & + P_{1i} P_{1c} + P_{2i} (1 - \sum_k P_{kc}) \\ & + P_{2c} (1 - \sum_k P_{ki}) \\ & + 1/2 (P_{1i} P_{2c} + P_{1c} P_{2i}) \end{aligned} \quad (\text{IV-12-25d})$$

$$\begin{aligned} P_2 = & 1/2 (P_{1i} P_{2c} + P_{1c} P_{2i}) \\ & + P_{3i} (1 - \sum_k P_{kc}) + P_{3c} (1 - \sum_k P_{ki}) \end{aligned}$$

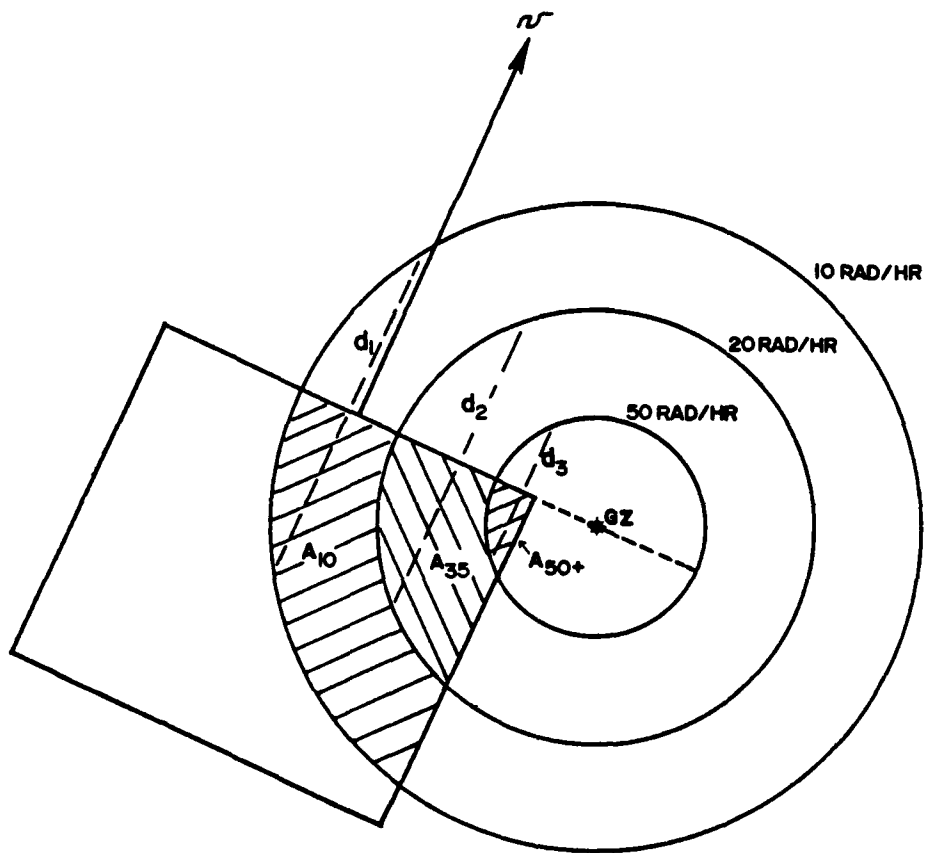


Figure IV-12-5. Barrier Assessment for a Moving Unit

$$\begin{aligned}
 &+ P_{2i} P_{2c} + P_{1i} P_{3c} + P_{1c} P_{3i} \\
 &+ 1/2 (P_{2i} P_{3c} + P_{2c} P_{3i}) \quad (IV-12-25e)
 \end{aligned}$$

$$\begin{aligned}
 P_3 &= 1/2 (P_{2i} P_{3c} + P_{2c} P_{3i}) \\
 &+ P_{3i} P_{3c} \quad (IV-12-25f)
 \end{aligned}$$

where:

- d_1, d_2, d_3 = new dose levels ($d_3 \geq d_2 \geq d_1$)
- P_1, P_2, P_3 = percent of the unit in each new dose level
- d_{1i}, d_{2i}, d_{3i} = previous unit dose levels ($d_{3i} \geq d_{2i} \geq d_{1i}$)
- P_{1i}, P_{2i}, P_{3i} = percent of the unit in each previous dose level
- d_{1c}, d_{2c}, d_{3c} = dose levels from current assessment ($d_{3c} \geq d_{2c} \geq d_{1c}$)
- P_{1c}, P_{2c}, P_{3c} = percent of the unit in each current dose level

(e) Equations IV-12-25 are intended to distribute the personnel having received a dose among the new dose levels such that the following conditions are satisfied:

1. Personnel having received no dose as the result of several assessments of the unit are not included in any of the dose levels.

2. Personnel having received an accumulated dose less than $1/2(d_1 + d_2)$ are included in level 1 (the lowest total dose).

3. Personnel having received an accumulated dose greater than $1/2(d_1 + d_2)$ but less than $1/2(d_2 + d_3)$ are included in level 2 (the intermediate total dose).

4. Personnel having received an accumulated dose greater than $1/2(d_2 + d_3)$ are included in level 3 (the highest total dose).

(f) For a unit with no previous radiation history the following is used in lieu of Equations IV-12-25:

- $P_1 = P_{1c}$
- $P_2 = P_{2c}$
- $P_3 = P_{3c}$

$$\cdot d_1 = d_{1c}$$

$$\cdot d_2 = d_{2c}$$

$$\cdot d_3 = d_{3c}$$

(g) As soon as some percentage of a unit's personnel accumulate a dose in excess of 50 rads, an assessment event is scheduled. These assessments are processed the same as delayed casualties with all event times determined by random numbers between the limiting times set forth in Figure IV-12-4.

(4) Radiation Barrier Update. Whenever a barrier is used in an assessment, or once an hour--whichever comes first--the barrier radii are reduced to reflect the decay. The time rate of decay of the radiation rate can be expressed by Equation IV-12-26:

$$\text{Rate}(t) = \text{Rate}(t=0)t^{-1.2} \quad (\text{IV-12-26})$$

Equation IV-12-26 is equated with Equation IV-12-19 to find the new slant ranges corresponding to the three dose rates. The result is similar to Equation IV-12-20 and is presented in Equation IV-12-27:

$$r_i = -\frac{1}{b} \ln \left(\frac{\text{Rate}_i t^{-1.2}}{a} \right) \quad (\text{IV-12-27})$$

APPENDIX A

NUCLEAR ASSESSMENT MODEL INPUT REQUIREMENTS

1. INTRODUCTION. The Nuclear Assessment Model is concerned with the delivery of nuclear munitions and the assessment of their effects. The purpose of this appendix is to provide instructions for data collection and entry into the Nuclear Assessment Model constant data base. Data unique to the model are addressed in this appendix. The order in which this chapter appears in this section is not indicative of the priority that should be assigned in the acquisition of data. The Nuclear Assessment Model data base may be loaded at any time after the Area Fire Model constant data load (Chapter 8 of this section) has been performed.

a. Information Needed. The model requires information on weapon accuracy, munition effects against both friendly and enemy equipment and personnel, fuze characteristics, and a precise definition of which combinations of delivery system, projectile, fuze, and yield are allowed within each force. Most of the data needed to load the Nuclear Assessment Model will be obtained from standard Army publications. The validity of the information to be entered in the data base is important to the performance of the model. For this reason, two forms are provided (munition type and equipment and Barrier/Facility Vulnerability) for use in obtaining an overview of the data.

b. Appendix Organization. The first paragraph of this appendix introduces the model, the type of data needed, and the organization of the appendix. The second paragraph provides a detailed discussion of the Nuclear Assessment Model data requirements and includes worksheets that may be used in accumulating the needed data. The remaining paragraphs give instructions for entering the accumulated data in card columns for loading the file.

2. DATA REQUIREMENTS. The Nuclear Assessment Model has two major data arrays which contain the bulk of the constant data unique to the model. First is the definition of munition type including specification of all required characteristics. Second is the specification of the vulnerability of all equipment items and barriers/facilities to each allowed yield. Additional requirements include the specification of unprotected personnel distribution in a nuclear environment, the damage radii for each yield as a function of height of burst, and several parameters related to induced radiation.

a. Munition Type:

(1) The Nuclear Assessment Model munition type is a four-character code, identical to that specified in the DSL fire order, which uniquely identifies the delivery system, projectile, warhead, fuze, and yield.

(a) The first character must be N or D. An N identifies the munition type as being an air-delivered nuclear round, missile, or bomb. A D identifies the munition type as atomic demolition munition (ADM). The model assumes no delivery error with ADM, and actual ground zero is set equal to desired ground zero.

(b) The second character may be any alphanumeric character. A single character must be assigned to each delivery system, projectile, and warhead combination. The model assumes a given character in the second position is related to a unique weapon item code, ammunition item code, range and deflection delivery error, minimum and maximum range, reaction time, and round velocity. When any two munition types differ in any of these parameters they must be identified with a different character in the second position.

(c) The third character is related to the munition fuze and may be any alphanumeric character. The model assumes a given character in the third position which relates to a unique height of burst option (the munition type either has a preset height of burst or it does not), impact option (the munition type either will detonate on impact or it will not), probable error in height of burst for each preset value of height of burst, and optimum delivery angle. When any two munition types differ in any of these parameters they must be identified by a different character in the third position.

(d) The fourth character specifies the yield and may be any alphanumeric character. Any two munition types which have different yields must be identified by a different character in the fourth position. A maximum of 30 yields is allowed by the Nuclear Assessment Model.

(2) The form for collecting munition type data is illustrated in Figure IV-12-A-1. Reference is made to this figure in the data definition instructions below.

(a) Select a munition type and enter the weapon item code in column B. Enter the ammunition item code in column C. If the weapon is a missile with a single item code which includes ammunition, enter the item code in both columns. For ADM put a zero in column B and go to step (d) below.

(b) If the munition type fuze has only preset values of height of burst, enter YES in column D; otherwise, enter NO. If column D contains NO, ignore column E. Otherwise, enter up to four preset values with their corresponding probable errors in height of burst in column E.

(c) If the munition type will detonate on impact, enter YES in column F; otherwise, enter NO.

(d) Enter the yield in column G.

(e) Enter a combination of four characters in column A. If column B contains a zero, the first character must be d; otherwise, it must be N.

(f) Select another munition type and repeat steps (a) through (d) above.

(g) If columns B and C are identical with any preceding munition type use the same first and second characters in column A; otherwise, enter D or N for the first character, as appropriate, and a new character in the second position.

Munition Type (A)	Weapon Item Code (B)	Ammo Item Code (C)	Preset HOB (D)	HOB(1) (E)	PEH(1)	HOB(2)	PEH(2)	HOB(3)	PEH(3)	HOB(4)	PEH(4)	IMPACT Detonation → (F)	Yield (G)

Figure IV-12-A-1. Munition Type Data Form

(h) If columns D, E, and F are identical with any preceding munition type the third character in column A is the same as for that munition type. If not, enter a new character in the third position.

(i) If column G is identical with any preceding munition type the fourth character in column A is the same as for that munition type. If not, enter a new character in the fourth position.

(j) Repeat steps (f) through (i) until all munition types have been considered.

(3) Use of the form in Figure IV-12-A-1 will simplify entering of data in card columns in addition to avoiding illegal character combinations. The munition type in the DSL fire order must exactly match an entry in column A.

b. Vulnerability:

(1) Each equipment type and each barrier/facility type must be related to a predefined damage index for munitions used by both forces. In some cases the equipment may be on the ground or in flight at the time of assessment, resulting in a requirement for two damage indexes. The damage index is a number between 1 and 30, assigned as follows:

<u>Damage Index</u>	<u>Damage Type</u>
1	Exposed personnel, prompt casualties
2	Exposed personnel, delayed casualties
3	Protected personnel, prompt casualties
4	Protected personnel, delayed casualties
5	Personnel in earth shelters, prompt casualties
6	Personnel in earth shelters, delayed casualties
7	Personnel in APCs, prompt casualties
8	Personnel in APCs, delayed casualties
9	Personnel in tanks, prompt casualties
10	Personnel in tanks, delayed casualties
11	Damage to equipment in flight
12	
13	
14	
15	Damage to equipment on the ground
16	
17	
18	
19	
20	
21	Tree blowdown
22	Fires, dry fuel
23	Fires, green fuel
24	Mines, ten percent detonation, type 1
25	Mines, ten percent detonation, type 2

<u>Damage Index</u>	<u>Damage Type</u>
26)	Open
27)	
28)	
29)	
30)	

(2) Based upon the availability of data, damage indexes 11-14 must be specifically defined to include those available values most useful in assessing equipment in flight. Similarly, damage indexes 15-20 must be defined for assessing equipment on the ground. Damage indexes 26-30 must be defined to include those available values most useful in assessing obstacles/facilities. Example options from which to choose are found in FM 101-31-2, Nuclear Weapons Employment Effects Data (Reference 2).

(3) A form for collecting the vulnerability data is provided in Figure IV-12-A-2. The form should be completed for each force to aid in entering data in card columns as well as to present an overview of the data.

(a) For each item code that is to be assessed on the ground enter in the appropriate column the damage index (15-20) as defined for both friendly and enemy munitions which most nearly corresponds to the equipment type identified by the specific item code. If an item code is not to be assessed on the ground make no entry.

(b) For each item code that is to be assessed in flight enter in the appropriate column the damage index (11-14) as defined for both friendly and enemy munitions which most nearly corresponds to the equipment type identified by the specific item code. If an item code is not to be assessed in flight make no entry.

(c) For each obstacle/facility to be assessed enter the obstacle/facility mnemonic in the first column. Enter in the appropriate column the damage index (21-30) as defined for both friendly and enemy munitions which most nearly corresponds to the obstacle/facility identified by the specific mnemonic.

c. Personnel Distribution Among Postures. In a nuclear environment, at the time a round of area fire munition impacts, personnel in the vicinity are considered to be in one of three possible postures: (1) in the open, (2) in foxholes, or (3) in earth shelters. Additionally, the consideration of personnel in the different postures is affected by the factor of being warned or unwarned. Figure IV-12-A-3 illustrates the data matrix.

(1) Form Headings. Across the top of the form are listed Activity, Percent Warned, Percent Unwarned, Minutes to Resume Unwarned Posture, and Time Spent in Activity. Along the left side are listed the various forms of activities.

AD-A112 657

ARMY COMBINED ARMS COMBAT DEVELOPMENTS ACTIVITY FORT--ETC F/G 15/7
DIVMAG MODEL DOCUMENTATION. VOLUME II. PROGRAMMER/ANALYST MANUA--ETC(U)
JUL 76

UNCLASSIFIED

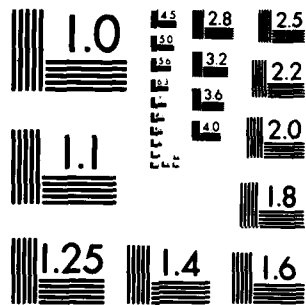
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DATE
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Force _____

Item Code	Friendly Munitions		Enemy Munitions	
	Ground	In Flight	Ground	In Flight
1				
2				
3				
4				
.				
.				
.				
.				
199				
200				
Obstacle/ Facility Mnemonic				

Figure IV-12-A-2. Vulnerability Data Form

FORCE _____									
Activity		Percent Warned			Percent Unwarned			Minutes to Resume Unwarned Posture (I)	Time Spent in Activity (J)
Type (A)	Code (B)	Open (C)	Foxhole (D)	Earth Shelter (E)	Open (F)	Foxhole (G)	Earth Shelter (H)		
Stay	1								
Stay	1								
Stay	1								
Move	2								
Fire	3								
Attack	4								
Defend	5								
Engineer	6								
Withdraw	7								

Figure IV-12-A-3. Personnel Postures, Nuclear Environment

(2) Percent Warned (Columns C-E). Warned personnel describe the personnel postures that troops normally assume after the first volley of conventional ammunition or a warning of a nuclear fire mission. Entries provide the breakdown of personnel among the three basic postures. All entries are in terms of percentages. Reading across a line, all percentages entered for warned personnel must add to 100 percent. Failure to do so will produce proportionate errors in the data output.

(a) Open (Column C). Enter the percent of personnel unprotected by equipment who would be in the open after being warned that area fires were about to come into the area.

(b) Foxhole (Column D). Enter the percentage of personnel who, when warned, would be in foxholes.

(c) Earth Shelter (Column E). Enter the percentage of personnel who, when warned, would be in earth shelters.

(3) Percent Unwarned (Columns F-H). Unwarned personnel postures are those in which troops will normally be, based on their activity when not under fire. Enter the percentage that would be found in the various positions (open, foxhole, earth, shelter) listed herein. Summing the percentage entries along any one line in this segment must equal 100.

(4) Minutes to Resume Unwarned Posture (Column I). Enter the elapsed time in minutes after all clear has sounded for personnel to regain unwarned postures. The change is from a more protected (warned) environment to a lesser protected (unwarned) environment.

(5) Time Spent in Activity (Column J). Enter the amount of time required to attain the postures previously listed. This column applies to the stay activity only. For a unit which has been in a stay activity for only a short period of time the percent of personnel in earth shelters or foxholes is generally less than for a unit which has been in a stay activity for an extended period of time.

d. Additional Data. Additional Nuclear Assessment Model data requirements may be found in a form which allows immediate transfer to card columns. Sources of these additional data are FM 101-31-2 (Reference 2) and TM 23-200, Capabilities of Nuclear Weapons (Reference 3).

3. WEAPON/MUNITION CHARACTERISTICS. Each combination of delivery system, projectile, warhead, fuze, and yield used in the Nuclear Assessment Model must have its capability parameters defined. For each weapon/munition combination the range limitations, error, delay times, and specification of allowable fuze options are required.

a. Format. The format of the weapon munition characteristics card is illustrated in Figure IV-12-A-4. The force indicator and munition type are character entries. All other entries are numeric. The yield entry is the

only entry on this card which must contain a decimal point. All other numeric entries must be rounded to the nearest whole number, and this whole number should be entered right justified.

b. Type and Force Identification (Columns 1-2). In column 1 the number 1 has been preprinted. Make no changes in this number. In column 2 enter only B or R, for Blue or Red force, respectively.

c. Munition Type (Columns 3-6). This four-column entry is to be taken from that developed in Figure IV-12-A-1. This same entry is required in the DSL fire order, so adequate preparation in developing this series of entries will be beneficial later in model operations.

d. Item Code (Columns 7-12). The weapon and munition item codes are to be entered in these columns.

(1) Weapon Item Code (Columns 7-9). Enter the item code of the primary equipment item required to deliver the specified munition type. This entry must agree with that developed in Figure IV-12-A-1.

(2) Munition Item Code (Columns 10-12). Enter the item code of the projectile or warhead or munition associated with the specified munition type. This entry must agree with that developed in Figure IV-12-A-1.

e. Yield (Columns 13-17). Enter the yield, in kilotons, of the specified munition type. A decimal point must be included in this entry and may be put in any of the five columns.

f. Range (Columns 18-29). The minimum and maximum ranges of this munition type are to be entered in these columns.

(1) Minimum Range (Columns 18-23). Enter the minimum range, in meters, of this munition type.

(2) Maximum Range (Columns 24-29). Enter the maximum range, in meters, of this munition type.

g. Error (Columns 30-41). The delivery errors associated with this munition type are to be entered in these columns.

(1) Range Dispersion (Columns 30-33). Enter the range dispersion, σ , in meters, for this munition type at mid range.

(2) Deflection Dispersion (Columns 34-37). Enter the deflection dispersion, σ , in meters, for this munition type at mid range.

(3) Probable Error in Height of Burst (Columns 38-41). Enter the probable error in height of burst, in meters, for this munition type.

h. Preset Height of Burst Indicator (Column 42). This indicator is required to designate if the fuze associated with the specified munition type allows only preset values of the desired height of burst or if a numeric height of burst specification must be a part of the fire order. If the fire order must include a numeric specification, in meters, of the desired height of burst enter a zero or leave this column blank. If the height of burst for this munition type is preset at one or more allowable heights of burst, a card type 1 must be completed for each allowable option in height of burst, the first such card should contain a 1 in column 42, the second card a 2, etc. No more than four height of burst options are allowed for any munition type.

i. Preset Height of Burst (Columns 43-45). Enter the preset height of burst, in meters, for this munition type and for the preset height of burst indicator which was entered in column 42. If the preset height of burst indicator in column 42 is zero, or if column 42 is left blank, leave these columns blank.

j. Impact Option Indicator (Column 46). The impact option indicator is required to designate if the specified munition type will detonate in the event it strikes the ground. If the munition type will not detonate upon impact enter a zero. If the munition type will detonate upon impact enter a 1.

k. Delay Time (Columns 47-49). Enter the reaction time, in minutes, required to go from State of Readiness I (maximum readiness) to firing this munition type.

l. Delivery Angle (Columns 50-51). Enter the angle of the incoming round relative to the horizon in degrees, which is most suitable for this munition type.

m. Projectile Velocity (Columns 52-56). Enter the projectile velocity, in meters per second, for this munition type.

n. Other Weapon/Munition Characteristics. The card illustrated in Figure IV-12-A-4 defines the characteristics of only one munition type; therefore, each munition type must be defined by a separate card. There may be a maximum of 1200 of card type 1 for each force. The ID of 3011 will appear in card columns 73-76.

4. WEAPON EFFECTS. The information required by this card format is a set of damage radii for as many as 30 damage indexes for each yield which was defined in the munition type specifications in card type 1. These data may be transferred directly from among existing effects tables in FM 101-31-2 (Reference 2) which provides for each yield and for each damage index (e.g., prompt personnel casualties in earth shelters) a set of damage radii as a function of height of burst. From among those values provided, four radii must be selected which correspond to the height of burst values which may be expected to cover the spectrum of desired values.

a. Card Format. The card format is depicted in Figure IV-12-A-5.

b. Card Type and Force Designator (Columns 1-2). The number 2 is preprinted in column 1. Enter in column 2 only R for Red or B for Blue weapon descriptions.

c. Yield (Columns 3-7). Enter the yield in kilotons. The decimal must be entered in these data. If the yield being described is 1 kiloton, enter 1.0; if the yield is 1 megaton, enter 1000.

d. Damage Index (Columns 8-9). The 30 damage indexes required by or allowed in the model were detailed in paragraph 2. Figure IV-2-A-6 illustrates an example of the effects table from FM 101-31-1 (Reference 1) which provides hypothetical unclassified nuclear weapon data. Several of the column headings are required by the model to correspond to specific values of the damage index. For example; PERSONNEL CASUALTIES IN APCs PRMPT was defined in paragraph 2 to be damage index 7. Other columns must be assigned damage index values according to which values are desired, subject to the constraints in paragraph 2. For example, the column labeled MOD DAM TO PKD HEL may be assigned a damage index between 15 and 20 and subsequently used to assess damage to equipment on the ground. No more than one column may be assigned the same damage index. Enter the damage index corresponding to the appropriate table column as a right justified integer in these card columns.

e. Height of Burst and Damage Radius (Columns 10-37). Space is provided in these columns for the specification of four values of height of burst and the four corresponding values of the damage radius.

(1) Height of Burst Value 1 (Columns 10-12). Reference is made to Figure IV-12-A-6. Select the smallest desired value of height of burst from among those presented in the column at the far left, labeled HOB, which is an exact multiple of 10. Enter the value in these columns as multiples of 10; e.g., enter 250 as 25. The entry is to be a right justified integer value.

(2) Damage Radius Value 1 (Columns 13-16). Enter the damage radius appropriate to the specified yield, damage index, and height of burst as a multiple of 10. For example, from Figure IV-12-A-6, if the specified yield is 1.0 kiloton, the damage index is 7, and the height of burst is 250, the appropriate damage radius is 500 and is entered in these columns as 50. The entry is to be a right justified integer value.

(3) Additional Values (Columns 17-37). Enter three additional values of height of burst and damage radius. The height of burst values must appear in increasing order of magnitude, and all four values must be specified. All entries are to be multiples of 10, right justified integer values.

f. Additional Yields and Damage Indexes (Columns 38-72). Four height of burst values and damage radii for an additional yield/damage index combination can be entered on this card format. The instructions for these entries are the same as those in the foregoing subparagraphs.

g. Additional Cards. There may be a maximum of 30 yields for each force, each of which may have 30 specified damage indexes. Thus, the maximum number of combinations is 900, resulting in 450 cards of this type; however, not all

SHORT RANGE CANNON
1.0 KT

EFFECTS TABLE
(Distances in meters)

MOB	PERSONNEL CASUALTIES IN APC'S		PERSONNEL CASUALTIES IN MDM TANKS		PERSONNEL CASUALTIES IN EARTH SHELTERS		PERSONNEL CASUALTIES IN MULTI-STORY APARTMENTS		PERSONNEL CASUALTIES IN FRAME BUILDINGS		SEV DAM SUP DEF		MOD DAM TO PKD HEL		SEV DAM TO ELEC EQUIP		SEV DAM TO OPEN GRD		RADAR ANT	FIXED	FLOAT
	PRMPT DELAY	PRMPT DELAY	PRMPT DELAY	PRMPT DELAY	PRMPT DELAY	PRMPT DELAY	PRMPT DELAY	PRMPT DELAY	PRMPT DELAY	PRMPT DELAY	SEV DAM TO SUP DEF	SEV DAM TO DEF	SEV DAM TO DEF	SEV DAM TO DEF	SEV DAM TO DEF	SEV DAM TO DEF	SEV DAM TO DEF				
550	110	530	0	310	0	0	220	580	260	600	0	0	1040	0	0	0	0	0	0	0	0
525	200	540	0	350	0	0	270	600	300	620	0	0	1070	0	0	0	0	0	0	0	0
500	250	550	0	380	0	0	320	620	340	640	0	0	1110	0	0	0	0	0	0	0	0
475	300	560	0	410	0	0	350	640	380	660	0	0	1160	0	0	0	0	0	0	0	0
450	330	570	0	440	0	0	380	660	420	680	0	0	1230	0	0	0	0	0	0	0	0
425	360	580	140	460	0	0	410	680	440	690	0	0	1310	0	0	0	0	0	0	0	0
400	390	590	200	490	0	130	440	690	520	710	0	0	1410	0	0	0	0	0	0	0	0
375	420	600	240	520	0	190	460	710	580	720	0	0	1430	0	0	0	0	0	0	0	0
350	440	610	280	540	0	230	480	720	630	730	0	0	1470	0	0	0	0	0	0	0	0
325	460	620	310	560	0	270	490	730	660	740	0	0	1590	0	0	0	0	0	0	0	0
300	470	630	320	570	0	290	510	740	680	750	0	0	1660	0	0	0	0	0	0	0	0
275	490	710	350	590	10	320	540	750	700	760	0	0	1730	0	0	0	0	0	0	0	0
250	500	720	370	590	120	340	550	760	740	770	0	0	1810	0	0	0	0	0	0	0	0
225	510	730	390	590	160	360	550	770	690	780	0	0	1890	0	0	0	0	0	0	0	0
200	520	740	400	600	190	370	560	780	670	790	0	0	1970	0	0	0	0	0	0	0	0
175	530	750	410	600	210	380	570	790	630	790	0	0	2050	0	0	0	0	0	0	0	0
150	540	760	420	610	230	390	570	790	630	800	0	0	2130	0	0	0	0	0	0	0	0
125	550	770	430	620	250	400	580	790	630	800	0	0	2210	0	0	0	0	0	0	0	0
100	560	780	440	630	260	410	580	790	590	810	0	0	2290	0	0	0	0	0	0	0	0
75	570	790	440	630	260	410	590	800	600	810	0	0	2370	0	0	0	0	0	0	0	0
50	580	800	440	630	270	420	590	800	600	810	0	0	2450	0	0	0	0	0	0	0	0
25	590	810	410	590	270	430	590	800	560	770	0	0	2530	0	0	0	0	0	0	0	0
0	600	820	410	590	240	380	550	760	560	770	0	0	2610	0	0	0	0	0	0	0	0

Figure IV-12-A-6. Example of Effects Table

yields must be specified nor all damage indexes defined. Each additional card required will have a 2 preprinted in column 1, and columns 73-76 will have the identification of 3011.

5. EQUIPMENT VULNERABILITY. The required data input for this card format is a reference from each equipment item code to the damage index value to be used in assessing the specific equipment type. During preparation of the weapon effects data several columns of the effects table should have been assigned damage indexes between 11 and 20 for assessment of equipment. All damage indexes in these card formats must be between 11 and 20.

a. Card Format. The card format for defining equipment vulnerability is illustrated in Figure IV-12-A-7.

b. Card Type and Force Designator (Columns 1-2). Column 1 has a preprinted 3. Enter in column 2 R or B to identify the force whose equipment is being described.

c. Item Code (Columns 3-5). Enter in these columns, right justified, the item code of the specific equipment type being described.

d. Transmission (Columns 6-7). The data required in these columns is the radiation transmission factor for the specified equipment type. The values may be found in FM 101-31-2 (Reference 2) in a table entitled Residual Radiation Transmission Factors for Troop Safety. If the equipment item affords no radiation shielding protection, leave these columns blank. The transmission factor is to be entered in these columns as a percentage, right justified. For example, enter a value of 0.3 as 30.

e. Equipment Type (Column 8). If equipment offers personnel protection from radiation equivalent to an APC enter an A; if protection is equivalent to a tank enter a T; otherwise, leave blank.

f. Assessment Type (Column 9). If the equipment vulnerability specification is for equipment in flight, enter A. Otherwise, enter S.

g. Damage Indexes (Columns 10-13). This entry associates equipment with the appropriate assessment radii of effect entered in card series 3011.

(1) Friendly (Columns 10-11). Enter the damage index, right justified, corresponding to the column in the effects table which is to be used in assessing damage to this equipment item according to the column definitions for friendly munitions.

(2) Enemy (Columns 12-13). Enter the damage index, right justified, corresponding to the column in the effects table which is to be used in assessing damage to this equipment item according to the column definitions for enemy munitions.

h. Additional Item Codes (Columns 14-68). Vulnerability data for as many as five additional item codes can be entered this card format. The instructions for making these entries are the same as those in the foregoing subparagraphs.

i. Additional Cards. The number of cards of this type is dependent upon the number of item codes to be assessed and the number of these items which may be assessed both on the ground and in flight. Each additional card will have a 3 preprinted in column 1, and columns 73-76 will have the identification 3011.

6. BARRIER/FACILITY VULNERABILITY. Data input required in this card format is a reference from each barrier/facility mnemonic to be assessed to one of the damage indexes (21-30) appropriate to the specific barrier/facility.

a. Card Format. The Barrier/Facility Vulnerability card format is presented in Figure IV-12-A-8.

b. Card Type (Column 1). The number 4 has been preprinted in column 1. Make no change to this number.

c. Barrier/Facility Mnemonic (Columns 3-5). Enter the first three characters of the barrier/facility mnemonic in these columns.

d. Damage Indexes (Columns 7-8, 10-11). The damage index corresponding to the appropriate effects table column to be used in assessing this barrier/facility is required for both Blue and Red munitions.

(1) Blue Munitions (Columns 7-8). Enter the damage index, right justified, as defined for Blue munitions.

(2) Red Munitions (Columns 10-11). Enter the damage index, right justified, as defined for Red munitions.

e. Additional Barriers/Facilities (Columns 13-71). Space is provided in this card format for the damage indexes to be used in assessing as many as six additional barriers/facilities. The instructions for entering these values are the same as those outlined above.

f. Additional Cards. The number of cards of this type required will be determined by the number of barriers/facilities to be assessed. Each will have the number 4 preprinted in column 1 and an identification number of 3011 in columns 73-76.

7. PERSONNEL POSTURES. The percentage of personnel in each of three postures, either warned or unwarned, in a nuclear environment is required for seven unit activities. The postures considered are: in the open, in foxholes, and in earth shelters. Two different card formats are to be used in specifying these data.

a. Activities Other Than Stay. Data for the six activities other than stay are required on this card format. Activities and codes are listed below.

[illegible]

Figure IV-12-A-8. Nuclear Barrier/Facility Vulnerability

Activity

<u>Type</u>	<u>Code</u>
Stay	1
Move	2
Fire	3
Attack	4
Defend	5
Engineer	6
Withdraw	7

(1) Card Format. The card format is provided in Figure IV-12-A-9.

(2) Type and Designator (Columns 1-2). As in all standard card formats in this volume, column 1 has been preprinted with a number, in this case 5. Make no change. In column 2 enter R for Red or B for Blue force.

(3) Activity Index (Column 5). A number 2 through 7 may be entered in this column as a code for the type of activity that the unit may be engaged in at any one time. This activity code is to be obtained from subparagraph a above. There are provisions to enter the percentage of personnel in each posture for three different activities. Detailed explanations will be given for this one activity, and data completion for the others will follow these instructions.

(4) Percentage of Personnel in Possible Postures (Columns 6-23). For the activity coded in column 5 enter the percentage of personnel that will be in the three postures indicated for warned and unwarned conditions.

(a) Unwarned Personnel (Columns 6-14). Assume that personnel have not been warned by either sirens for air alerts, rounds falling into the area from enemy fires, or by observers who would give advanced notice of fire about to fall on the area.

1. Exposed (Columns 6-8). Enter the percentage of personnel, in accordance with the activity coded in card column 5, that would be in the open.

2. Foxhole (Columns 9-11). Enter the percentage of personnel, in accordance with the activity coded in card column 5, that would be in foxholes.

3. Earth Shelter (Columns 12-14). Enter the percentage of personnel, in accordance with the activity coded in card column 5, that would be in earth shelters.

(b) Warned Personnel. The foregoing situation found personnel who were not warned that enemy fire would be in the area. In this situation they are warned, usually through rounds falling in their midst. The warning

may also come from observers or through sirens in the area, which would declare an alert. Personnel would be in the less protected postures, under conditions of being warned, only because their duties so required. On this basis the percentage in more exposed positions should be less than that experienced for the unwarned positions.

1. Exposed (Columns 15-17). Enter the percentage of personnel that would be in the open even after being warned that enemy fires were to fall in the area.

2. Foxhole (Columns 18-20). Enter the percentage of personnel that would be in foxholes after being warned that enemy fires were to fall in the area, in accordance with the activity.

3. Earth Shelter (Columns 21-23). Enter the percentage of personnel that would be in earth shelters after being warned that enemy fires were to fall in the area.

(c) Minutes to Resume Unwarned Posture (Columns 24-25). Enter the average time lapse, to the nearest minute, between the time of the nuclear fire until the time at which all personnel can be assumed to have returned to unwarned postures.

(5) Additional Activities (Columns 28-69). Personnel percentages for the three postures can be entered for two additional activities on this card format. The instructions for making these entries are the same as those in the foregoing subparagraphs with the exception of the change in activity.

(6) Additional Cards. Two cards are required for each force in order to record for data base purposes the percentage of personnel in three postures for all six activities. Each of these cards will have a 5 preprinted in column 1 and an identification number 3011 in columns 73-76.

b. Stay Activity. Personnel in a unit which is in a stay activity are allowed to increase their protection as a function of the amount of time they are in that activity. The data requirements are a specification of the percentage of personnel in each posture along with a specification of the time spent in the stay activity for three such times.

(1) Card Format. The card format for personnel postures in the stay activity is illustrated in Figure IV-12-A-10.

(2) Card Type and Force Indicator (Columns 1-2). A 6 is preprinted in column 1. Enter either B for Blue or R for Red in column 2.

(3) Minutes to Resume Unwarned Posture (Columns 3-4). Enter the time, in minutes, between the time of a nuclear fire or warning of such a fire and the time at which all personnel can be assumed to have returned to unwarned postures.

(4) Activity Code (Column 5). The number 1 has been preprinted in this column to identify the stay activity. Make no changes in this number.

(5) Time Spent in Stay Activity (Columns 6-7). Enter the time, in hours, spent in the stay activity, for which personnel postures are being specified. The entry is to be right justified.

(6) Percentage of Personnel in Possible Postures (Columns 8-25). For the stay activity enter the percentage of personnel in the three postures indicated for both warned and unwarned conditions which is expected for a unit which has been in the stay activity for the specified period of time. The instructions are the same as for activities other than stay and will not be repeated.

(7) Additional Times (Columns 28-71). Space is provided in this card format for the specification of personnel postures for two additional times spent in the activity. The percentage of personnel in foxholes and earth shelters will be expected to increase with the amount of time in the stay activity.

(8) Card Identification. For each force there will be only one card with a 6 preprinted in column 1. Each will have an identification number of 3011 in columns 73-76.

8. RADIATION BARRIERS. The radius to which radiation rates of various magnitudes extend from ground zero is dependent upon the yield of the weapon and the soil type. This card format provides the space for entering the necessary data pertinent to induced radiation barriers.

a. Card Format. The card format is presented in Figure IV-12-A-11.

b. Card Type (Column 1). The number 7 is preprinted in this column.

c. Radiation Radii (Columns 3-26). Graphs may be found in TM 23-200, Reference 3, which provide the induced gamma radiation rates expected to exist 1 hour after blast as a function of slant range. Three such graphs exist corresponding to three yield regions: (1) subkiloton yields, (2) kiloton yields, and (3) megaton yields. The required data are to be obtained from these graphs.

(1) Subkiloton Yields (Columns 3-10). Enter in columns 3-6 the slant range, in yards, corresponding to a radiation rate of 0.1 rads per hour per ton. Enter in columns 7-10 the slant range, in yards, corresponding to a radiation rate of 0.005 rads per hour per ton.

(2) Kiloton Yields (Columns 11-18). Enter in columns 11-14 the slant range, in yards, corresponding to a radiation rate of 5.0 rads per hour per kiloton. Enter in columns 15-18 the slant range, in yards, corresponding to a rate of 0.005 rads per hour per kiloton.

INDUCED RADIATION BARRIER												
CARD TYPE	TON		KILOTON		MEGATON		SOIL TYPE MULTIPLIER		CARD ID	CARD SEQ. NR.		
	R ₁	R ₂	R ₁	R ₂	R ₁	R ₂						
1	1	1	1	1	1	1	1		1	1		
2	2	2	2	2	2	2	2		2	2		
3	3	3	3	3	3	3	3		3	3		
4	4	4	4	4	4	4	4		4	4		
5	5	5	5	5	5	5	5		5	5		
6	6	6	6	6	6	6	6		6	6		
7	7	7	7	7	7	7	7		7	7		
8	8	8	8	8	8	8	8		8	8		
9	9	9	9	9	9	9	9		9	9		
10	10	10	10	10	10	10	10		10	10		
11	11	11	11	11	11	11	11		11	11		
12	12	12	12	12	12	12	12		12	12		
13	13	13	13	13	13	13	13		13	13		
14	14	14	14	14	14	14	14		14	14		
15	15	15	15	15	15	15	15		15	15		
16	16	16	16	16	16	16	16		16	16		
17	17	17	17	17	17	17	17		17	17		
18	18	18	18	18	18	18	18		18	18		
19	19	19	19	19	19	19	19		19	19		
20	20	20	20	20	20	20	20		20	20		
21	21	21	21	21	21	21	21		21	21		
22	22	22	22	22	22	22	22		22	22		
23	23	23	23	23	23	23	23		23	23		
24	24	24	24	24	24	24	24		24	24		
25	25	25	25	25	25	25	25		25	25		
26	26	26	26	26	26	26	26		26	26		
27	27	27	27	27	27	27	27		27	27		
28	28	28	28	28	28	28	28		28	28		
29	29	29	29	29	29	29	29		29	29		
30	30	30	30	30	30	30	30		30	30		
31	31	31	31	31	31	31	31		31	31		
32	32	32	32	32	32	32	32		32	32		
33	33	33	33	33	33	33	33		33	33		
34	34	34	34	34	34	34	34		34	34		
35	35	35	35	35	35	35	35		35	35		
36	36	36	36	36	36	36	36		36	36		
37	37	37	37	37	37	37	37		37	37		
38	38	38	38	38	38	38	38		38	38		
39	39	39	39	39	39	39	39		39	39		
40	40	40	40	40	40	40	40		40	40		
41	41	41	41	41	41	41	41		41	41		
42	42	42	42	42	42	42	42		42	42		
43	43	43	43	43	43	43	43		43	43		
44	44	44	44	44	44	44	44		44	44		
45	45	45	45	45	45	45	45		45	45		
46	46	46	46	46	46	46	46		46	46		
47	47	47	47	47	47	47	47		47	47		
48	48	48	48	48	48	48	48		48	48		
49	49	49	49	49	49	49	49		49	49		
50	50	50	50	50	50	50	50		50	50		
51	51	51	51	51	51	51	51		51	51		
52	52	52	52	52	52	52	52		52	52		
53	53	53	53	53	53	53	53		53	53		
54	54	54	54	54	54	54	54		54	54		
55	55	55	55	55	55	55	55		55	55		
56	56	56	56	56	56	56	56		56	56		
57	57	57	57	57	57	57	57		57	57		
58	58	58	58	58	58	58	58		58	58		
59	59	59	59	59	59	59	59		59	59		
60	60	60	60	60	60	60	60		60	60		
61	61	61	61	61	61	61	61		61	61		
62	62	62	62	62	62	62	62		62	62		
63	63	63	63	63	63	63	63		63	63		
64	64	64	64	64	64	64	64		64	64		
65	65	65	65	65	65	65	65		65	65		
66	66	66	66	66	66	66	66		66	66		
67	67	67	67	67	67	67	67		67	67		
68	68	68	68	68	68	68	68		68	68		
69	69	69	69	69	69	69	69		69	69		
70	70	70	70	70	70	70	70		70	70		
71	71	71	71	71	71	71	71		71	71		
72	72	72	72	72	72	72	72		72	72		
73	73	73	73	73	73	73	73		73	73		
74	74	74	74	74	74	74	74		74	74		
75	75	75	75	75	75	75	75		75	75		
76	76	76	76	76	76	76	76		76	76		
77	77	77	77	77	77	77	77		77	77		
78	78	78	78	78	78	78	78		78	78		
79	79	79	79	79	79	79	79		79	79		
80	80	80	80	80	80	80	80		80	80		
81	81	81	81	81	81	81	81		81	81		
82	82	82	82	82	82	82	82		82	82		
83	83	83	83	83	83	83	83		83	83		
84	84	84	84	84	84	84	84		84	84		
85	85	85	85	85	85	85	85		85	85		
86	86	86	86	86	86	86	86		86	86		
87	87	87	87	87	87	87	87		87	87		
88	88	88	88	88	88	88	88		88	88		
89	89	89	89	89	89	89	89		89	89		
90	90	90	90	90	90	90	90		90	90		
91	91	91	91	91	91	91	91		91	91		
92	92	92	92	92	92	92	92		92	92		
93	93	93	93	93	93	93	93		93	93		
94	94	94	94	94	94	94	94		94	94		
95	95	95	95	95	95	95	95		95	95		
96	96	96	96	96	96	96	96		96	96		
97	97	97	97	97	97	97	97		97	97		
98	98	98	98	98	98	98	98		98	98		
99	99	99	99	99	99	99	99		99	99		
100	100	100	100	100	100	100	100		100	100		

Figure IV-12-A-11. Induced Radiation Barrier

(3) Megaton Yields (Columns 19-26). Enter in columns 19-22 the slant range, in yards, corresponding to a radiation rate of 50 rads per hour per megaton. Enter in columns 23-26 the slant range corresponding to a rate of 0.1 rads per hour per megaton.

d. Soil Type Multiplier (Columns 27-31). TM 23-200, Reference 3, also contains a table of soil type multipliers. From this table select the soil type most suitable to the situation and enter the appropriate multiplier in these columns. The decimal must be entered in this value.

e. Card Identification. There may be only one card with a 7 preprinted in column 1, and it will have the identification number 3011 entered in columns 73-76.

9. NUCLEAR MODEL CONSTANT DATA DECK STRUCTURE. This paragraph describes the data deck structure for constant data input used in the Nuclear Assessment Model. The cards making up the deck and the order in which they must be read into the DIVWAG System are discussed.

a. Nuclear Model Constant Data Input Cards. The cards for the Nuclear Assessment Model constant data input are listed in Figure IV-12-A-12. The figure shows card type, title, and identification. The far right column shows the program used to load the data.

Card Type	Card Title	Card ID	Load Program Name
1	Nuclear Weapon Munition Characteristics	3011	NUCLD
2	Nuclear Weapon Effects	3011	NUCLD
3	Nuclear Weapon Equipment Vulnerability	3011	NUCLD
4	Nuclear Barrier/Facility Vulnerability	3011	NUCLD
5	Nuclear Environment Personnel Posture	3011	NUCLD
6	Nuclear Environment Personnel Posture for Stay Activity	3011	NUCLD
7	Induced Radiation Barrier Data	3011	NUCLD

Figure IV-12-A-12. Nuclear Assessment Model Constant Data Input Cards

b. Creating Constant Data Files. The Nuclear Assessment Model constant data input file is created by reading in the data deck structured as illustrated in Figure IV-12-A-13. The subdecks that form the Nuclear Assessment Model data deck, with Blue force data preceding Red force data are shown. At the left side of the figure are 6 groupings of card formats, which are used to assemble the subdecks for both Blue and Red.

(1) Card Groupings. Figure IV-12-A-13 shows in position one the induced radiation barrier data, card type 7, card ID 3011. There is only one card type 7 required in the Nuclear Assessment Model data deck structure and this must be the first card in the deck. Immediately behind the card type 7 is a header card with the number 1 in card column 1. The number 1 is the only entry required on this card and signifies that the data for card type 1, nuclear weapon munition characteristics, card ID 3011 follows. The remaining groupings are each preceded by a header card with the number of the appropriate card type in card column one as shown in Figure IV-12-A-13. All the Blue force cards are arranged first and assembled as part of the Blue force subdeck. The Red force cards are assembled into their own subdeck, and the two are then submitted for read in to the computer system. A card with the characters 00000000 punched in columns 73 through 80 must follow the Red force subdeck.

(2) Subdeck Structure. After the groupings of cards are aligned as shown in Figure IV-12-A-13, all Blue force cards are then assembled for the first subdeck. The Red force nuclear data are organized in the 6 groupings as shown at the left of the figure. The data deck is then ready for insertion of the system control cards and submission to the data processing center for creation of the Nuclear Assessment Model constant data input files.

c. Updating Nuclear Assessment Model Constant Data Files. Changes to the data read into the constant data files for the Nuclear Assessment Model can be readily accomplished through the use of the retained Nuclear Assessment Model data deck. The updating may consist of correction of an error in one data element, the deletion of information, or the addition of new data.

(1) Correcting an Error. The card with the error or data to be changed is located and a new card produced with the correct or changed data punched in. The old card is removed from the deck, and the new card is inserted in its location. The entire data deck for both Red and Blue forces is then submitted for another run on the computer system. The recreation of the constant data files through reading in the data deck with the changed data on cards constitutes the correction of an error or the changing of a data element.

(2) Deletion of Information. To delete a data element, select the card or cards having unwanted data. These cards are removed from the data deck, and the purged deck is then submitted for reread to the computer system. The omission of cards will cause that data to be eliminated from the data base in the process of recreating the constant data files for the Nuclear Assessment Model.

(3) Addition of Data. Data may be added at any time prior to the start of the game. Prepare the cards that are to have the data added and integrate them into the data deck by placing each of the card formats in the appropriate subdeck as illustrated in Figure IV-12-A-13. When these cards have been accurately integrated into the data deck the completed and expanded data deck is then submitted to the computer system for reread. Each time data are entered in the Nuclear Assessment Model constant data input file printouts are generated showing the new file information.

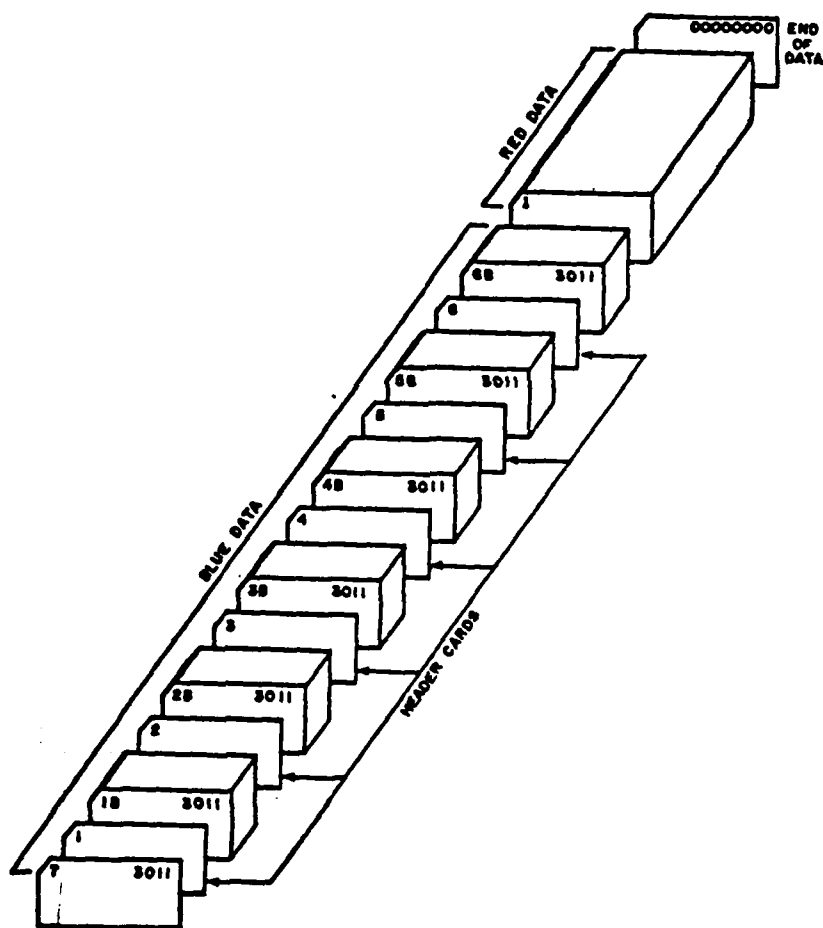


Figure IV-12-A-13. Nuclear Assessment Model Data Deck Structure

APPENDIX B

NUCLEAR ASSESSMENT MODEL PROGRAM DESCRIPTIONS

1. INTRODUCTION:

a. General. Routines used to simulate nuclear fire and assess its damage are contained in overlay 10 of the DIVWAG Period Processor. The overlay contains a main area and four segments.

(1) The main area of overlay 10 is composed of the overlay controlling routine, NAM, that calls the various segments as appropriate, a geometric calculation routine, BANCIR, used to calculate overlap of nuclear damage circles with targets, and CFUN that provides the necessary interface with the rest of the model.

(2) Segment 1 calculates prompt casualties. The segment is entered through a routine, NAM1, that generates a call to the routine ASUNIT, the controlling routine of the segment.

(3) Segment 2 calculates barrier damage and updates radiation barriers. It is entered through a routine, NAM2, that calls the segment controlling routine NBARAS.

(4) Segment 3, controlled by the routine NFIRE, simulates round firing and impact and, as a secondary function, computes radiation radii around a blast.

(5) Segment 4 contains routines for sensor assessment, for calculation of delayed casualties, and passage through a radiation barrier. Logical control is accomplished by the routine NAM4.

b. Sequence of Operations. The flow of operations through this overlay is complicated by the segment structure. The basic entry point is the routine NAM. To process a nuclear fire, NAM calls in sequence the routines NFIRE (segment 3), ASUNIT (segment 2), SASSMT (segment 4), and NFIRE (segment 3). These calls simulate firing the round, prompt assessment to units, sensor assessments and radiation radii, respectively. The Engineer Model is activated through automatic event scheduling to identify barriers, and NBARAS (segment 2) to assess barriers. The overlay may also be entered, keyed by other models, to update radiation barriers through NBARAS (segment 2), to assess delayed casualties through NCUNIT (segment 4), or to dose units passing through radiation areas using BAMUNT (segment 4). Routines are described in the following paragraphs in the general sequence that they are called.

2. ROUTINE NAM:

a. Purpose. NAM is the driving routine for the Nuclear Assessment overlay. It calls segments as they are needed for flow through the model.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
ISEG	TWO	The segment control code.

c. Output Variable. ISEG.

d. Logical Flow (Figure IV-12-B-1):

(1) Block 1. If this is a call to NFIRE (ISEG equals one or two), control goes to block L2.

(2) Block 2. If this is to assess a unit passing through a nuclear barrier or to update a unit for delayed losses (ISEG not equal to negative six or negative nine), control goes to block 3.

(3) Block L3. This process block is to update barrier records for radiation radii decay or to assess barriers within the damage radius of a nuclear blast. Call segment 2 and return control to the calling routine.

(4) Block 3. Call segment 4 and return control to the calling routine.

(5) Block L2. Call segments 3, 1, 4, and 3 in sequence. This allows routines in these segments to call routines in the other segments. Return control to the calling routine.

3. ROUTINE NAM4:

a. Purpose. NAM4 routes a call to segment 4 of the Nuclear Assessment overlay to the proper routine for sensor assessment, delayed losses, or passage through a radiation barrier.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
ISEG	TWO	Segment control code.

c. Output Variables. None.

d. Processing Description. NAM4 calls routine SASSMT for sensor assessment, if ISEG equals two; calls BAMUNT for passage through a radiation barrier, if ISEG equals negative eight; otherwise, it calls NCUNIT for delayed losses.

4. ROUTINES NAM1 AND NAM2:

a. Purpose. NAM1 and NAM2 serve as the entry points of segment 1 and segment 2 respectively.

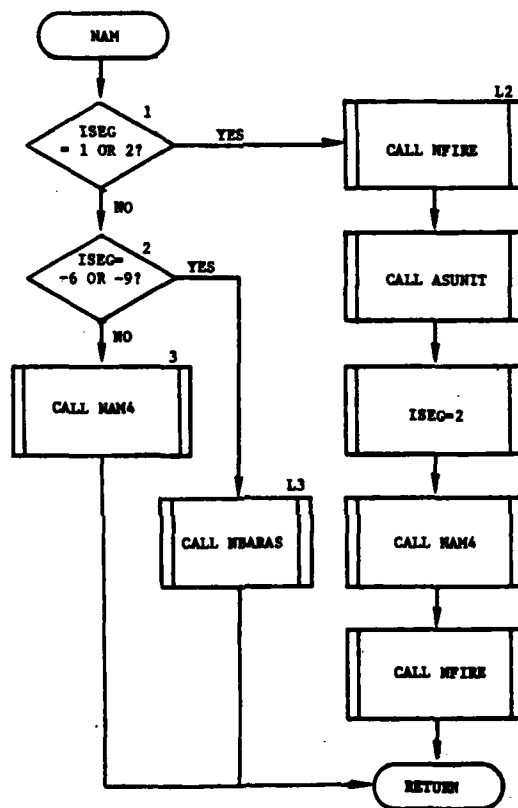


Figure IV-12-B-1. Routine NAM

b. Input Variables. None.

c. Output Variables. None.

d. Routine description. NAM1 calls ASUNIT; NAM2 calls NBARAS.

5. ROUTINE NFIRE:

a. Purpose. NFIRE accesses data for the Nuclear Assessment Model and determines if the order to fire is legal. It calls routines to:

- . Compute height of burst and the coordinates of actual ground zero
- . Set the damage radii for the round
- . Compute losses of equipment and personnel by units in the damage radius
- . Assess and create barriers.

b. Input Variables. Standard common block area, UMAIN.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
AGZX	TWO	X coordinate of actual ground zero.
AGZY	TWO	Y coordinate of actual ground zero.
AHOB	TWO	Actual height of burst.
RYEILD	TWO	Actual yield of the warhead fired.
NUCRAD(30)	TWO	Damage radii (30 possible) of this round.
ULIST(200)	TWO	IUIDs of units inside the largest damage radius.
FILE12(35)	TWO	Engineer event description record. FILE12(16). The 2-rad-per-hour radiation radius. FILE12(17). The 20-rad-per-hour radiation radius. FILE12(18). The 50-rad-per-hour radiation radius.

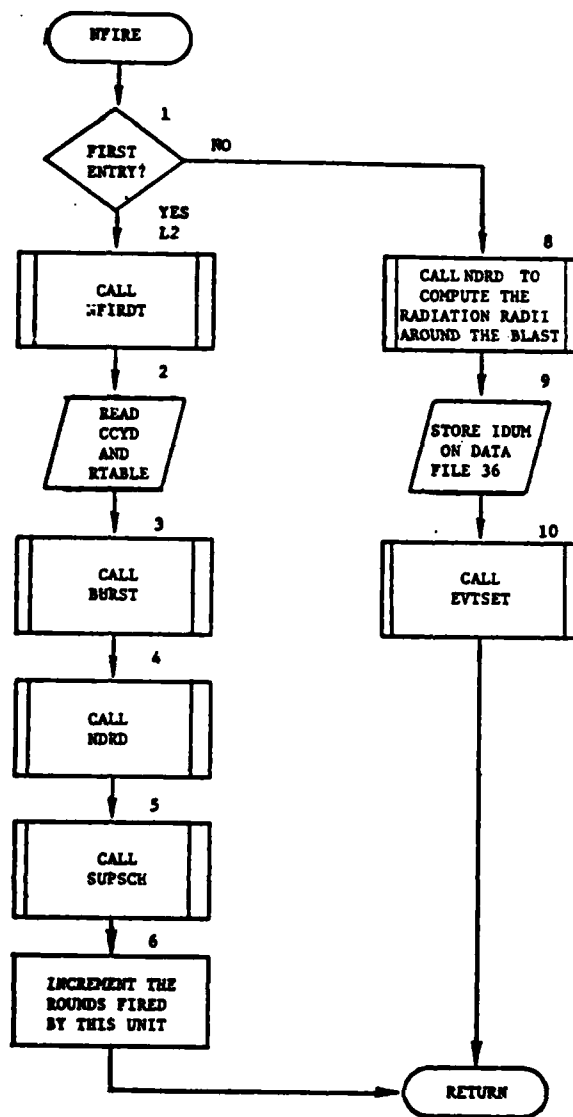


Figure IV-12-B-2. Routine NFIRE

d. Logical Flow (Figure IV-12-B-2):

(1) Block 1. If this is the first time NFIRE has been entered for this round (ISEG equals one), control goes to block L2.

(2) Block 8. The blast has been computed and prompt assessment has been made. Compute the radii of radiation around the blast.

(3) Block 9. Store the contents of IDUM on data file 36 so it will be saved while the Engineer Model creates the nuclear barrier and searches for all barriers in the damage radii.

(4) Block 10. EVTSET schedules a call to the Engineer Model to determine which barriers are to be assessed. Control then returns to NAM.

(5) Block L2. Call NFIRDT to determine if the range requested is compatible with the data specifications. It also checks the desired combination of weapon, warhead, and fuze to determine if it is available within the fire unit. If the fire mission request is not allowed, a message is printed and the mission is aborted.

(6) Block 2. Bring in the array of character codes for yields and use it to index the table of yields. Fill RTABLE from the table of yields for later use in determining the damage radii of the round.

(7) Block 3. Call BURST to compute the coordinates of actual ground zero and the actual height of burst.

(8) Block 4. Call NDRD to calculate the 30 possible damage radii associated with this blast.

(9) Block 5. Call SUPSCH to build a list of all units contained in the largest damage radius.

(10) Block 7. Increment the rounds fired by this fire unit and decrement the number of rounds available. Return control to the calling routine.

6. ROUTINE NFIRDT:

a. Purpose. NFIRDT checks a request to fire a nuclear weapon to determine if the weapon and warhead have been defined in the firing unit's data. It also checks the fuze and requested height of burst for legality and determines if the target is within range.

b. Input Variables:

(1) Standard Common Block Area. UMAIN.

(2) Other Variables:

Name	Source	Contents
IFD	Call	Flag for method of specifying height of burst.

<u>Name</u>	<u>Source</u>	<u>Contents</u>
WWNAME(1200)	DF30	Array of defined weapon-warhead character codes.
WWSTAT(9,100)	DF30	Table of statistics for weapon-warhead combinations.
FAYT(7,300)	DF30	Table of statistics for fuzes.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
IXTRA(17)	TWO	<p>Array containing selected statistics of weapon, warhead, and fuze.</p> <p>IXTRA(1). Character code for weapon-warhead combination.</p> <p>IXTRA(2). Equipment item code of the weapon.</p> <p>IXTRA(3). Equipment item code of the warhead.</p> <p>IXTRA(4). Standard deviation in range.</p> <p>IXTRA(5). Standard deviation in deflection.</p> <p>IXTRA(6). Pointer to the first entry in the fuze array.</p> <p>IXTRA(7). Angle of the round.</p> <p>IXTRA(8). Velocity of the round.</p> <p>IXTRA(9). Time required for delivery from state of readiness one.</p> <p>IXTRA(10). Code for the fuze.</p> <p>IXTRA(11). Impact detonation flag.</p> <p>IXTRA(12). Airburst flag.</p> <p>IXTRA(13). Desired height of burst if airburst flag is on.</p> <p>IXTRA(14). Probable error in height of burst.</p> <p>IXTRA(15). Minimum range for the combination.</p>

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
		IXTRA(16). Maximum range for the combination.
		IXTRA(17). Force indicator of firer.
IDELW	Call	Equipment item code of the weapon.
IWWHD	Call	Equipment item code of the warhead.
NDELT	Call	Time required for delivery from state of readiness one.

d. Logical Flow (Figure IV-12-B-3):

- (1) Block 1. Bring in the array of weapon-warhead combination name codes.
- (2) Block L1. If the name requested has been defined, control goes to block L2.
- (3) Block 2. Print a message indicating why the weapon will not be fired, set a flag to indicate it will not be fired, and return control to the calling routine.
- (4) Block L2. Bring in the table of weapon-warhead combination statistics and the table of fuze data.
- (5) Block 3. If the requested fuze was not defined for this combination, control goes to block 2.
- (6) Block 4. If the height of burst is not to be specified in the fire order, control goes to block L41.
- (7) Block 5. If the height of burst specification is not allowed, control goes to block 2.
- (8) Block L48. If the target is not within range, control goes to block 2; otherwise, return control to the calling routine.
- (9) Block L41. If no height of burst option is specified, control goes to block L48.
- (10) Block 6. If the option is not allowed, control goes to block 2; otherwise, it goes to block L48.

7. ROUTINE BURST:

a. Purpose. BURST computes the actual height of burst of the round and the actual ground zero coordinates of the burst, by incorporating the expected errors in height of burst, range, and deflection.

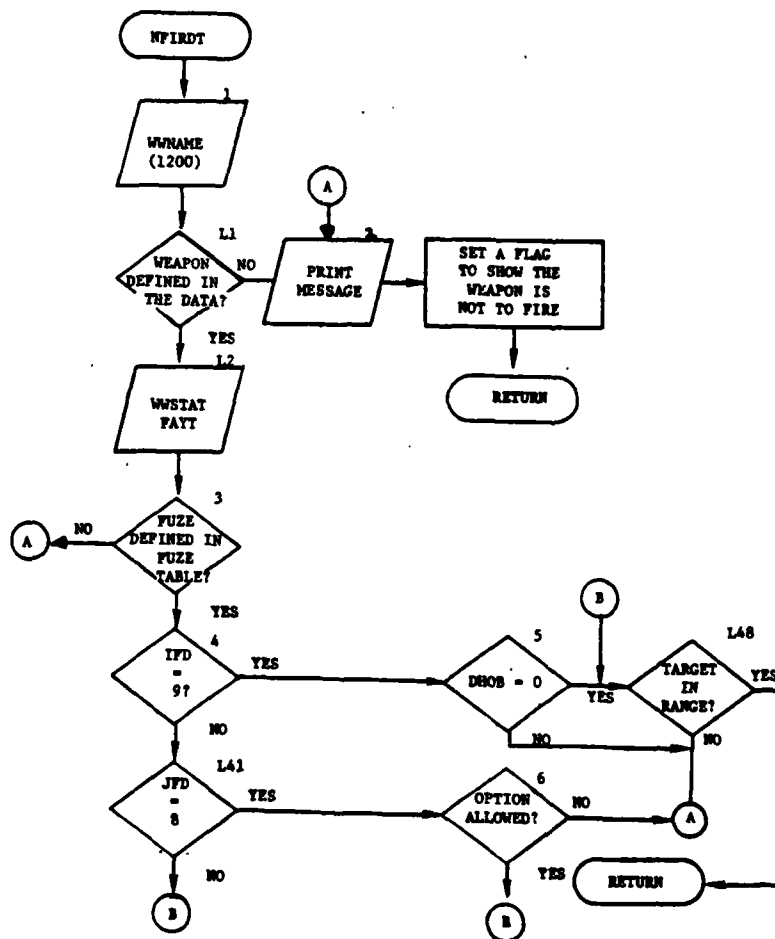


Figure IV-12-B-3. Routine NFIRD

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
WX	Call	X coordinate of the fire unit.
WY	Call	Y coordinate of the fire unit.
DGZX	Call	X coordinate of desired point of burst.
DGZY	Call	Y coordinate of desired point of burst.
DHOB	Call	Desired height of burst.
SIGMAD	Call	Standard deviation of deflection.
SIGMAR	Call	Standard deviation of range.
PEH	Call	Probable error in height of burst.
VTHETA	Call	Delivery angle of the round.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
AGZX	Call	The actual ground zero X coordinate of the blast.
AGZY	Call	The actual ground zero Y coordinate of the blast.
AHOB	Call	The actual height of burst of the round.

d. Logical Flow (Figure IV-12-B-4):

(1) Blocks 1 and 2. Call ENORM to get the deviation in height of burst for this round using the probable error in height of burst. Add this to desired height of burst to get the actual height of burst.

(2) Blocks 3 and 4. Call ENORM to get the deviation in range and deflection for this round. Modify the deviation in range to be deviation in range less deviation in height, the quantity divided by the tangent of the delivery angle.

(3) Block 5. Compute the distance from desired ground zero to the fire unit and compute the actual ground zero coordinates using desired coordinates, deviations in range and deflection, and the distance from fire unit to desired ground zero.

8. ROUTINE NDRD:

a. Purpose. This routine determines the damage radius associated with the actual height of burst from the tabulated values for each of the 30 damage radii.

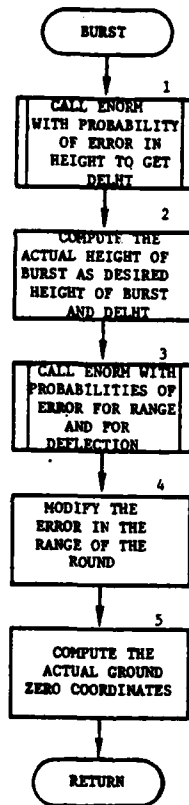


Figure IV-12-B-4. Routine BURST

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
METH	Call	Indicator of the method of radii calculations.
IMPACT	Call	Flag indicating impact explosion option.
AHOB	TWO	The actual height of burst of the round.
RTABLE(4,60)	TWO	The table of values of radii for height of burst.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
NUCRAD(30)	TWO	Array of damage radii for this round.

d. Logical Flow (Figure IV-12-B-5):

(1) Block 1. If the height of burst desired is zero and the impact option is not allowed, control goes to block L3.

(2) Block 2. Compute the damage radius using the tabulated values of damage radii for specified heights of burst.

(3) Block 3. If this was not the last of the 30 possible damage radii, control goes to block 2; otherwise, it returns to the calling routine.

(4) Block L3. Set all radii in NUCRAD to zero and return control to the calling routine.

9. ROUTINE SUPSCH:

a. Purpose. SUPSCH calls routine SEARCH twice to get two lists of units within the damage radius specified. It then merges these two lists into one.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
UID	Call	Unit identifier of the firing unit.
KOUIR	TWO	Unit identifier of the firing unit with the force designator reversed.
AGZX	TWO	X coordinate of actual ground zero of the blast.
AGZY	TWO	Y coordinate of actual ground zero of the blast.

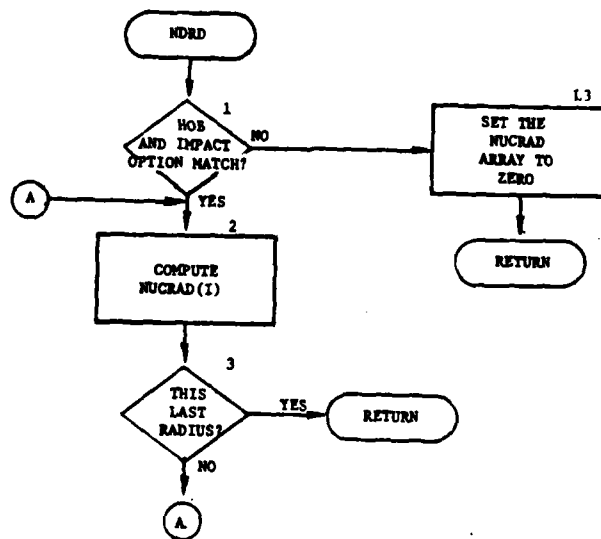


Figure IV-12-B-5. Routine NDRD

<u>Name</u>	<u>Source</u>	<u>Contents</u>
DRRAD	TWO	Radius within which to search for units.
M	TWO	Maximum number allowed per list of units.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
ULIST(800)	TWO	Combined list of enemy and friendly units within the damage radius.
ISTI	TWO	Total number of enemy units on ULIST plus one.
IFNSH	TWO	Total number of units on ULIST.

d. Logical Flow (Figure IV-12-B-6):

(1) Block 1. Call SEARCH to create a list of all enemy units in the damage radius.

(2) Block 2. Call SEARCH to create a list of all friendly units in the damage radius.

(3) Blocks 3, 4, and 5. If there were no units of either force within the damage radius, print a message and return control to the calling routine.

(4) Blocks 6 and 7. Add the friendly units to the list of enemy units and return control to the calling routine.

10. ROUTINE ASUNIT:

a. Purpose. ASUNIT controls processing of prompt losses of equipment and personnel to units inside the damage radius.

b. Input Variables:

(1) Standard Common Block Areas. UMAIN and UCOOP.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IFNSH	TWO	Maximum number of units to assess.
ISTI	TWO	Index of the first friendly unit to assess.
IFORCE	TWO	Force indicator of the firing unit.
LSEOH2(200,10)	DF6	Table of secondary equipment items.

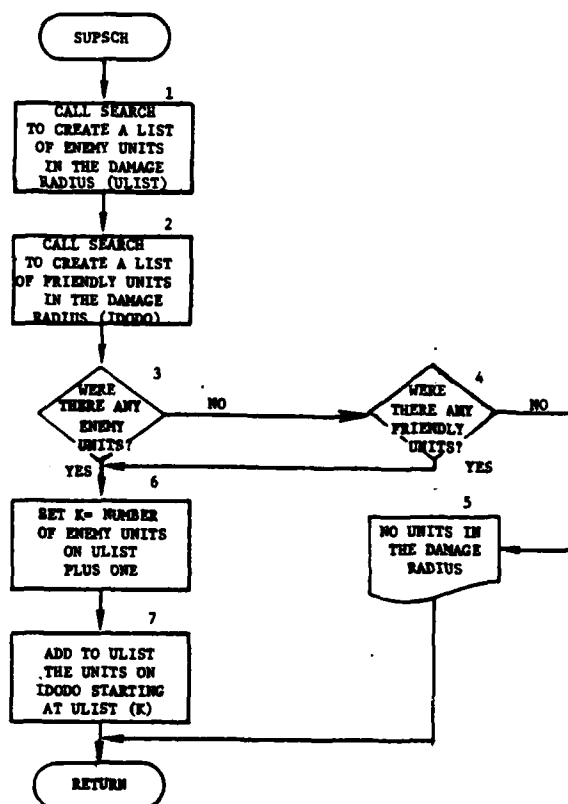


Figure IV-12-B-6. Routine SUPSCH

<u>Name</u>	<u>Source</u>	<u>Contents</u>
EOHLNK(200)	DF30	Array of pointers from equipment items to damage radii.
UDDTBL(199)	DF28	Array of band distribution by activity.
UNPRO(7)	DF30	Array of unprotected personnel distribution by unit activity and warned status.
EOHPRO(100,3)	DF30	Array of items protecting personnel.
NUCRAD(30)	TWO	Array of damage radii.
AGZX	TWO	X coordinate of actual ground zero.
AGZY	TWO	Y coordinate of actual ground zero.
AHOB	TWO	Actual height of burst.

c. Output Variables:

- (1) Standard Common Block Areas. UMAIN and UCOOP.
- (2) Other Variables. Same as input with the destination to common.

d. Logical Flow (Figure IV-12-B-7):

- (1) Block 1. Initialize a loop through the units to assess one to IFNSH.
- (2) Block 2. If this is not the first friendly unit to assess, control goes to block 4.
- (3) Block 3. Bring in the table of secondary items for this force.
- (4) Block 4. Bring in the unit status record of the unit to assess.
- (5) Block 5. Call HEMOVN to determine if the unit is moving and, if so, to compute its present location. If the unit has moved out of the damage area, it will be skipped.
- (6) Block 6. Bring in the array of pointers linking equipment items to damage radii, the distribution tables for the units, and the unprotected personnel distribution table.
- (7) Block 7. Call UPRMPT to assess prompt losses against this unit.
- (8) Block 8. Replace the updated unit status record of the unit just assessed.

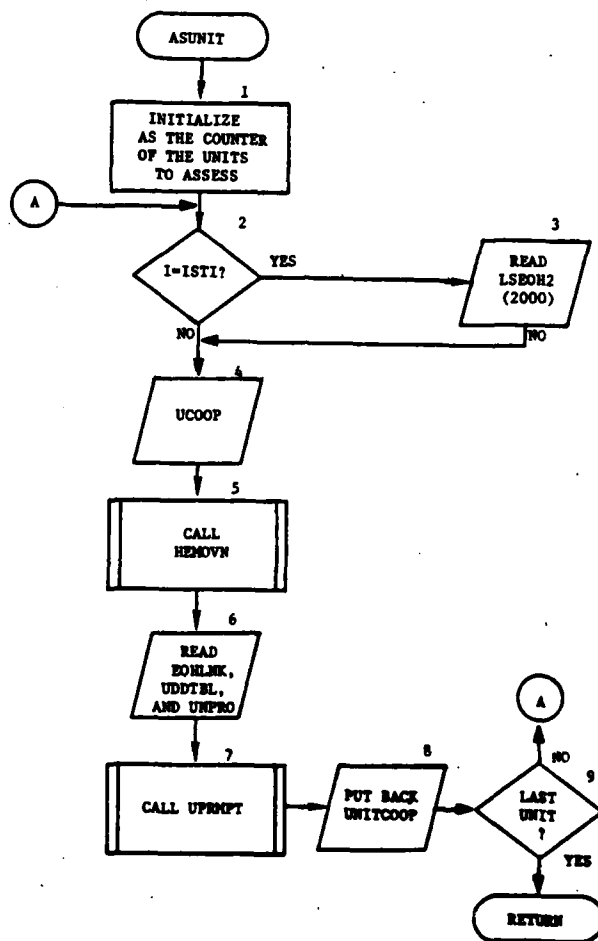


Figure IV-12-B-7. Routine ASUNIT

(9) Block 9. If this was not the last unit to be assessed, control goes to block 2; otherwise, return control to the calling routine.

11. ROUTINE HEMOVN:

a. Purpose. HEMOVN determines if a unit is moving and, if so, whether the unit is still in the damage radius. If the unit is still within the radius, the flag returned will be equal to one; if not, the flag will be equal to two. HEMOVN also computes the actual coordinates of the unit at the present time.

b. Input Variables:

(1) Standard Common Block Area. UCOOP.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
AGZX	TWO	X coordinate of actual ground zero of the blast.
AGZY	TWO	Y coordinate of actual ground zero of the blast.
DRRAD	TWO	Damage radius.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
TGTX	TWO	X coordinate of the unit at the present time.
TGTY	TWO	Y coordinate of the unit at the present time.
ITIME	TWO	Time the move will be completed.
K	TWO	Indicator that the unit is still in the damage radius.

d. Logical Flow (Figure IV-12-B-8):

(1) Block 1. Initialize the target coordinates and the flag indicating if the unit is still in the damage radius.

(2) Block 2. Call GET EVT to determine if the unit is moving.

(3) Block 3. If the unit is not moving, return control to the calling routine.

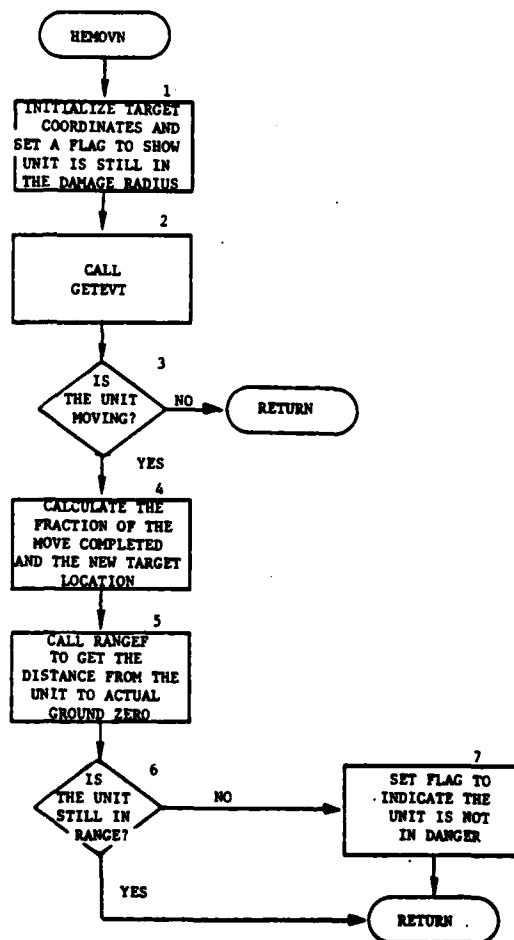


Figure IV-12-B-8. Routine HEMOVN

- (4) Block 4. Compute the present location of the unit.
- (5) Block 5. Compute the distance from the unit to the blast.
- (6) Block 6. If the unit is still within range, return control to the calling routine.
- (7) Block 7. If the unit has moved out of range, set a flag and return control to the calling routine.

12. ROUTINE UPRMPT:

a. Purpose. UPRMPT assesses immediate casualties to both equipment and personnel in any unit contained in the damage radius of a nuclear blast. It calls SCORE and OASSES to record the effects of the blast.

b. Input Variables:

- (1) Standard Common Block Areas. UMAIN and UCOOP.
- (2) Other Variables. Same as in ASUNIT (paragraph 10b(2)).

c. Output Variables:

- (1) Standard Common Block Areas. UMAIN and UCOOP.
- (2) Other Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
OUTEQP(200)	TWO	Array of items lost by the unit.

d. Logical Flow (Figure IV-12-B-9):

- (1) Block 1. Call NASEOH to assess equipment items.
- (2) Block 2. Call NASPER to assess personnel.
- (3) Block 3. Call EOH2OT to assess secondary equipment items attached to the lost primary items.
- (4) Block 4. Call SCORE to update the score board.
- (5) Block 5. Call OASSES to put out an assessment record.
- (6) Block 6. Update the unit status record to show equipment items lost.
- (7) Block 7. Call EVTSET to schedule the assessment of delayed casualties. Control returns to the calling routine.

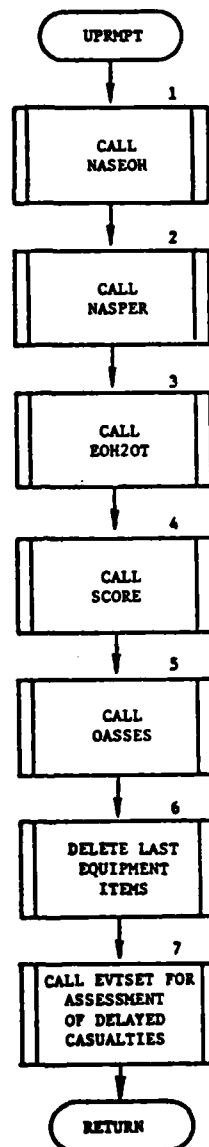


Figure IV-12-B-9. Routine UPRMPT

13. ROUTINE NASPER:

a. Purpose. NASPER assesses unprotected and protected personnel in each band of the unit being assessed, within the proper damage radii. It also adds the casualties due to lost equipment.

b. Input Variables:

(1) Standard Common Block Areas. UMAIN and UCOOP.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
NBANDS(7)	TWO	Total number of bands in a unit by activity.
INILP	TWO	Starting value of a loop on damage radii.
MXLP	TWO	Maximum value of a loop on damage radii.
INCRLP	TWO	Increment value of a loop on damage radii.
IXBIAS	TWO	Indicator of the warned or unwarned status of the unit.
PERSD(7)	TWO	Array of personnel distribution by band and unit activity.
EOHPRO(3,100)	TWO	Array of personnel protected by equipment items.
OUTEQP(200)	TWO	Equipment losses for this assessment.
TPERS	TWO	Total number of personnel in the unit.
UNPRO(7)	TWO	Array of personnel distribution per band in the three postures.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
CAS	TWO	Total number of unprotected personnel lost by this unit.

d. Logical Flow (Figure IV-12-B-10):

(1) Blocks 1 and 2. Initialize the number of casualties (CAS) to zero, and set L equal to one to initialize a loop on the three postures.

(2) Block 3. Call CFUN to get the area of overlap with each band of the unit and the damage radius (I).

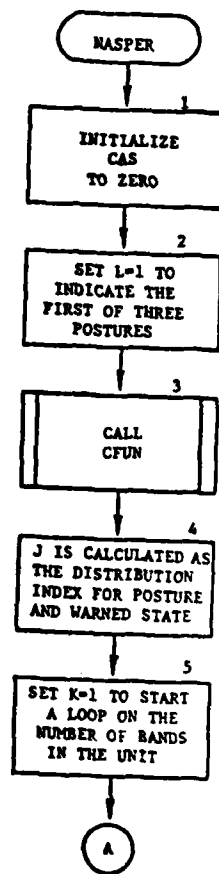


Figure IV-12-B-10. Routine NASPER (Continued on Next Page)

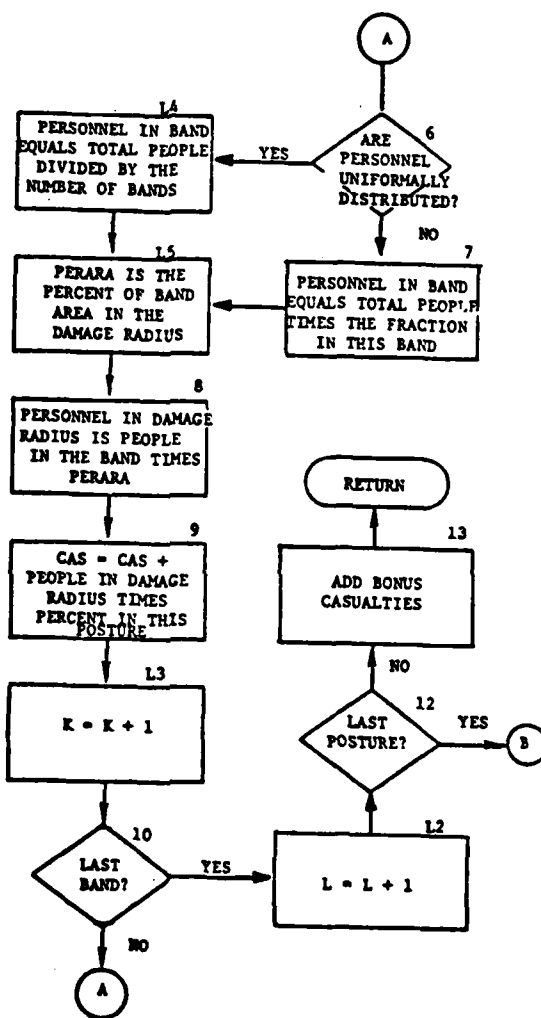


Figure IV-12-B-10. Routine NASPER (Concluded)

(3) Blocks 4 and 5. Compute J as the distribution index for posture and warned status of the personnel in the unit, and set K equal to one to initialize a loop on the total number of bands in the unit.

(4) Blocks 6 and L4. If the personnel in the unit are uniformly distributed, the number of personnel in the band (PERS) is equal to the total number of personnel divided by the number of bands. Control goes to block L5.

(5) Block 7. The total number of personnel in the band is the total number of personnel times the fraction in this band, which is located in the array of personnel distribution per band by unit activity.

(6) Block L5. Calculate the percent of band area contained in the damage radius (PERARA).

(7) Block 8. The total number of personnel in the damage radius is the total number in the band times the percent in the radius.

(8) Block 9. Use J to index the array of unprotected personnel distribution by posture and warned status. Casualties (CAS) are increased by personnel in the damage radius times the percent in this posture.

(9) Block L3. Increase the index of the band loop (K) by one.

(10) Block 10. If this was not the last band, control transfers to block 7.

(11) Blocks L2 and 12. Increase the index of the posture (L1) by one. If this was not the last posture, control goes to block 3.

(12) Block 13. Add the bonus casualties due to equipment losses and return control to the calling routine.

14. ROUTINE NASEOH:

a. Purpose. NASEOH assesses equipment items against the proper damage radii. It also provides information to NASPER to assess personnel in tanks and armored personnel carriers.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
LSEOH2(200,10)	TWO	Secondary equipment list for force being assessed.
UCOOP(500)	TWO	Unit status record of unit being assessed.
EOHLNK(200)	DF30	Array of links from equipment items to damage radii.

<u>Name</u>	<u>Source</u>	<u>Contents</u>
PEPFLG(200)	DF30	Indicator whether equipment item is tank, armored personnel carrier, or other.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
OUTEQP(200)	TWO	Array of lost equipment.
PANOUT(20)	TWO	A packed word with total number of equipment items and equipment item code for delayed equipment losses.

d. Logical Flow (Figure IV-12-B-11):

- (1) Block 1. Bring in, from data file 6, the secondary equipment array for the force of the unit being assessed.
- (2) Block 2. Bring in, from data file 30, the array of links from equipment item codes to damage radii.
- (3) Block 3. Check each equipment item. If an item is secondary equipment and the unit has primary equipment, zero its equipment link. It will be assessed with the primary equipment.
- (4) Block 4. Initialize a loop through equipment items to check if this item's link equals the damage radii. If not, control goes to block 17.
- (5) Block 5. If this unit does not have equipment items, control goes to block 17.
- (6) Block 6. Call CFUN to calculate the area of overlap between the unit and the blast using this damage radius.
- (7) Block 7. Bring in, from data file 30, the assessment flag for this item.
- (8) Block 8. If this item is not assessed as a tank, control goes to block 9.
- (9) Blocks 8A and 8B. Prepare to call CFUN with damage radii 9 and 10 set; then, control goes to block 11.
- (10) Block 9. If this item is not assessed as an armored personnel carrier, control goes to block 10.
- (11) Blocks 9A and 9B. Prepare to call CFUN with damage radii 7 and 8. Control goes to block 11.

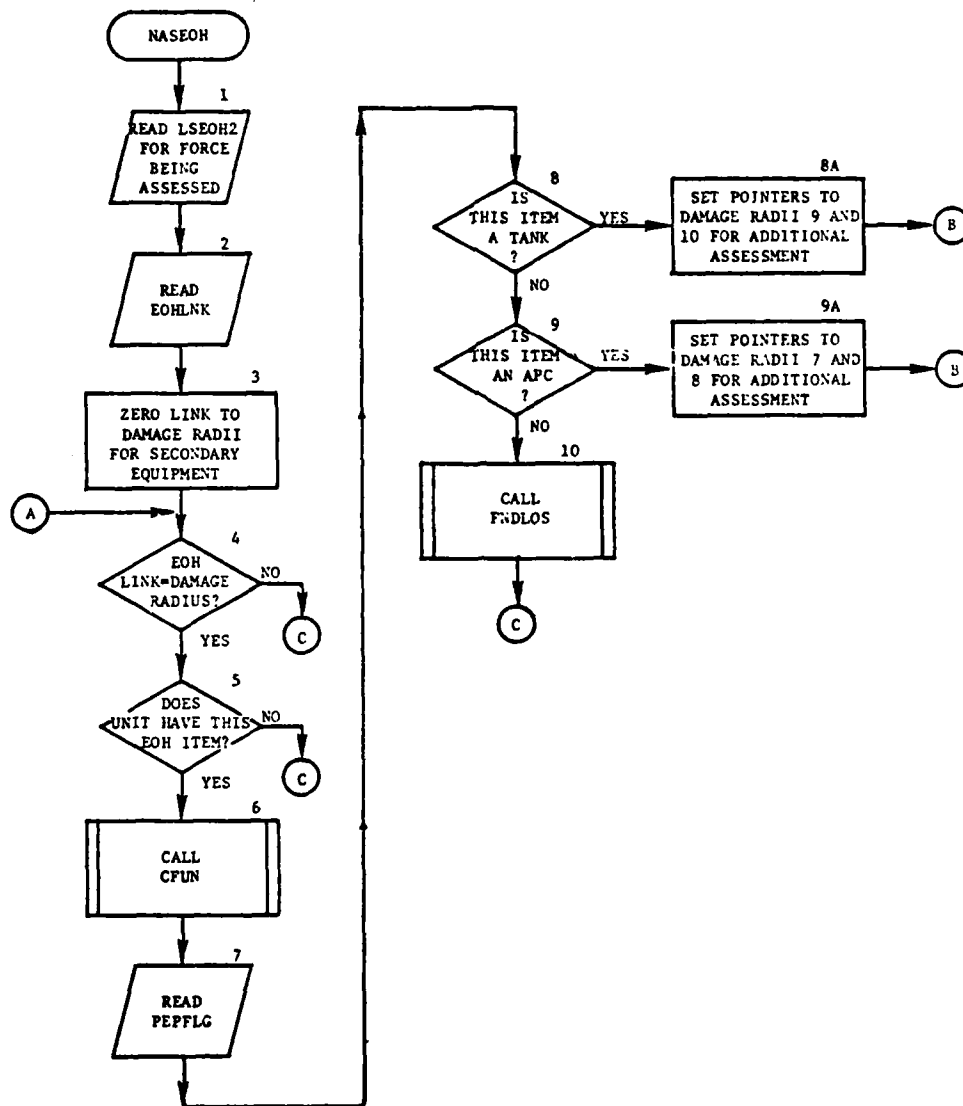


Figure IV-12-B-11. Routine NASEOH (Continued on Next Page)

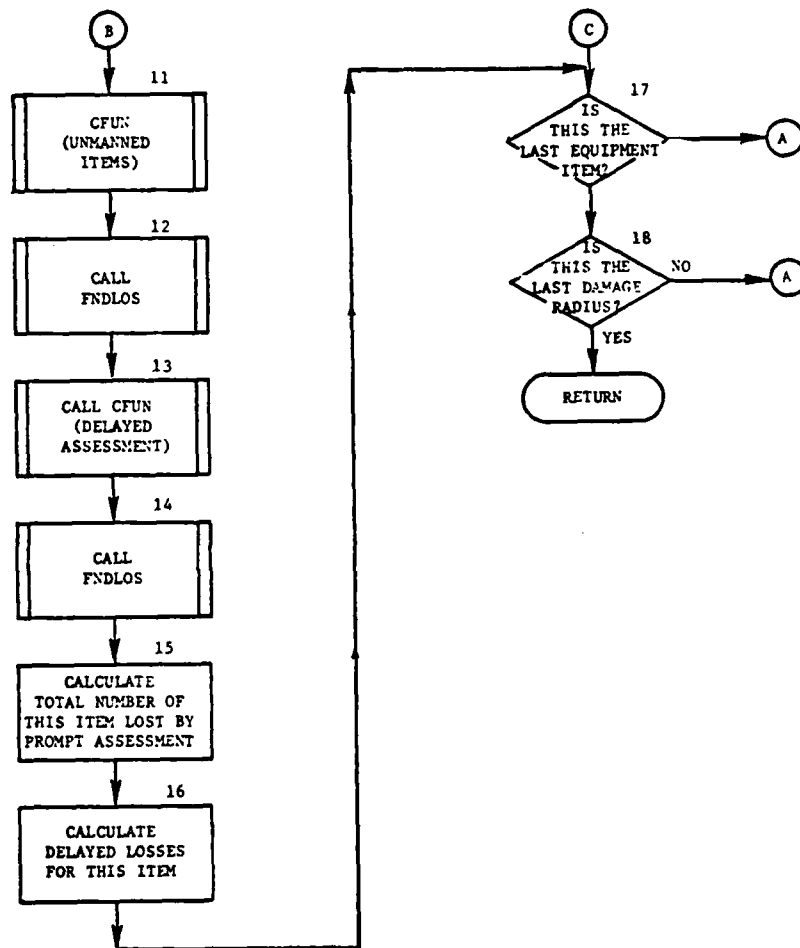


Figure IV-12-B-11. Routine NASEOH (Concluded)

(12) Block 10. Call FNDLOS to calculate equipment losses that are not a tank, or armored personnel carrier. Control goes to block 17.

(13) Block 11. Call CFUN to calculate the area of overlap between the unit and the blast using the radius where the item is not damaged but it is lost because personnel were killed.

(14) Block 12. Call FNDLOS to find the number of items lost in this category.

(15) Block 13. Call CFUN to calculate the area of overlap between the unit and the blast using radius for delayed assessment.

(16) Block 14. Call FNDLOS to find the number of items lost in this category.

(17) Block 15. Calculate the number of items lost by direct damage and loss of crew.

(18) Block 16. Calculate the total number of items lost by delayed assessment.

(19) Block 17. If this is not the last item, control goes to block 4.

(20) Block 18. If this is not the last damage radius, control goes to block 4.

15. ROUTINE FNDLNK:

a. Purpose. FNDLNK searches an array specified in the parameter list for a number, beginning the search at a location in the array also specified in the parameter list. It returns the first index of the array greater than or equal to the search starting location that contains the number. If the number is not found, the index returned is zero.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
EOHLNK(200)	Call	Array of links from equipment items to damage radii.
I	Call	The link to search for in EOHLNK.
L	Call	The index of EOHLNK at which to begin search.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
K	Call	The index of EOHLNK that contains I.

d. Logical Flow (Figure IV-12-B-12):

(1) Blocks 1 and 2. Set K equal to zero (flag indicates item not found), and set J (loop index) to L (point in array to start search).

(2) Blocks L1, L2, 3, and 4. If EOHLNK(J) equals I (code searched for), set K equal to J and return control to the calling routine; otherwise, continue loop incrementing J to a maximum value of 200. Return control to the calling routine if loop completed without finding a match.

16. ROUTINE FNDLOS:

a. Purpose. FNDLOS computes the number of losses suffered by a specified equipment item in each band of a specified unit. If the item is not uniformly distributed among the bands, the correct distribution percentages from EOHD are retrieved and each band is assessed accordingly.

b. Input Variables:

(1) Standard Common Block Area. UCOOP.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
AMTEOH	Call	Total amount of the item possessed by the unit.
L	Call	The equipment item code number of the item.
EOHLST(20)	TWO	List of equipment items that are nonuniformly distributed over the bands.
EOHD(7,20)	TWO	Array of the band distribution by unit activity of each unit in the EOHLST array.
AREACM(4)	TWO	The area in each band contained in the damage radius.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
TEMEOH	Call	Total amount of the equipment item lost by the unit.

d. Logical Flow (Figure IV-12-B-13):

(1) Blocks 1, 2, and L9. Initialize the temporary equipment loss to zero, calculate the total area of one band of this unit, and initialize a loop on the bands of the unit.

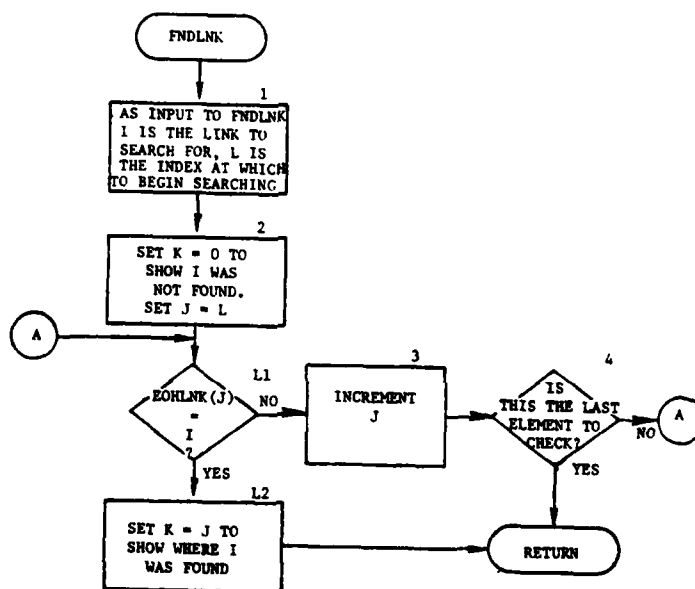


Figure IV-12-B-12. Routine FNDLNK

(2) Block L10. If the item is uniformly distributed over the bands (not on array EOHLSST), control goes to block 3; otherwise, processing continues at block L11.

(3) Blocks L11 and 5. Get the percent of the total amount of this item contained in this band from EOHD. If the distribution is zero, control goes to block 8.

(4) Block 6. The amount in this band (BNDEOH) is the total amount in the unit multiplied by the percent in this band. Control goes to block 4.

(5) Block 3. The amount in this band (BNDEOH) is the total amount divided by the number of bands.

(6) Blocks 4 and 7. Compute the percent of the band area in the damage radius (PERARA) and increase the temporary equipment loss by BNDEOH multiplied by PERARA.

(7) Blocks 8 and 9. Increase the count of the number of bands. If there are more bands to assess, control goes to block L10; otherwise, return control to the calling routine.

17. ROUTINE NPEPL:

a. Purpose. NPEPL checks a specified equipment item code number to determine how many personnel are protected by that item.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
L	Call	Item number of the item to check.
EOHPRO(100,3)	Call	Table of personnel protection data for equipment items.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
NPEPL	Call	Total number of personnel protected by the specified item.

d. Processing Description. The array EOHPRO contains item codes and number of personnel protected associated with an item. The array is searched for presence of the desired item code and the associated number protected returned as NPEPL. If no item code match is found, NPEPL is returned as zero.

18. ROUTINE STUPRO:

a. Purpose. STUPRO fills the array of unprotected personnel distributions for a unit in a stay activity. It checks the necessary length of time before the next group of five possible groups of data can be used. When the correct group of data has been selected, STUPRO returns the array.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
ITMPRO	Call	Length of time the unit has been in the stay activity.
IRWRB	Call	Record number to access on data file 30.
NUCENV	Call	Environment code (nuclear or nonnuclear).
UNPRO(7)	DF30	Array of unprotected personnel distribution.
DNPRO(7)	DF30	Temporary array of unprotected personnel distribution.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
UNPRO(7)	Call	Array of unprotected personnel distribution for this unit's activity and environment.

d. Logical Flow (Figure IV-12-B-14):

(1) Block 1. Calculate the address of the first word of the record from which the array is to be filled, using the indicator of nuclear or nonnuclear environment.

(2) Block 2. Fill the array (UNPRO) from data file 30.

(3) Block 3. Increase the counter of the number of words taken from data file 30 by seven.

(4) Block 4. Fill the array (DNPRO) from data file 30.

(5) Block 5. If the time the unit has been in this stay activity is less than the seventh word of DNPRO, return control to the calling routine.

(6) Block 6. Set UNPRO equal to DNPRO. If there is another group of data for UNPRO (K is less than 28), control goes to block 3; otherwise, return control to the calling routine.

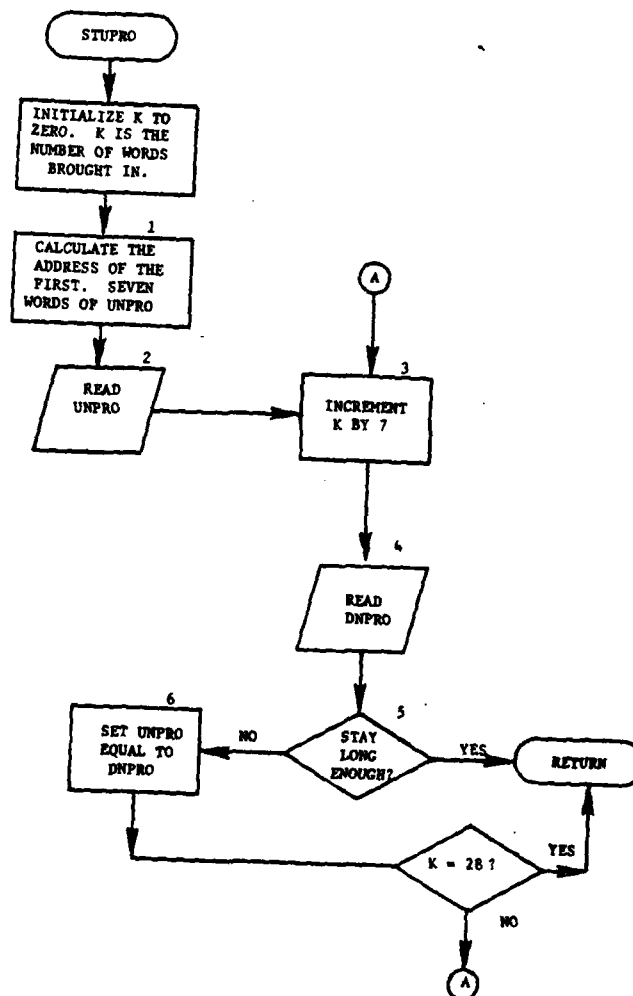


Figure IV-12-B-14. Routine STUPRO

IV-12-B-35

19. ROUTINE CFUN:

a. Purpose. CFUN uses the routine BANCIR to calculate the overlapping areas of a circle and a rectangle. If the rectangle is a unit, CFUN calculates the corresponding area for each band.

b. Input Variables:

- (1) Standard Common Block Areas. UMAIN and UCOOP.
- (2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
NUCRAD(30)	TWO	The array of 30 possible damage radii.
IDR	TWO	The pointer to the radius to use.
AGZX	TWO	X coordinate of actual ground zero of the blast.
AGZY	TWO	Y coordinate of actual ground zero of the blast.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
AREACM(4)	TWO	The area in each band contained in the damage radius.

d. Logical Flow (Figure IV-12-B-15):

- (1) Block 1. Initialize the number of width and depth increments to be used in the approximation in BANCIR.
- (2) Block 2. If the width of the rectangle is greater than one, control goes to block 3.
- (3) Block 2A. Set the number of width increments equal to one.
- (4) Block 3. If the depth of the rectangle is greater than one, control goes to block 4.
- (5) Block 3A. Set the number of depth increments equal to one.
- (6) Block 4. Calculate the coordinates of the center of the band.
- (7) Block 5. Call the routine BANCIR to calculate the area of overlap between this band or rectangle and the circle with the given damage radius.

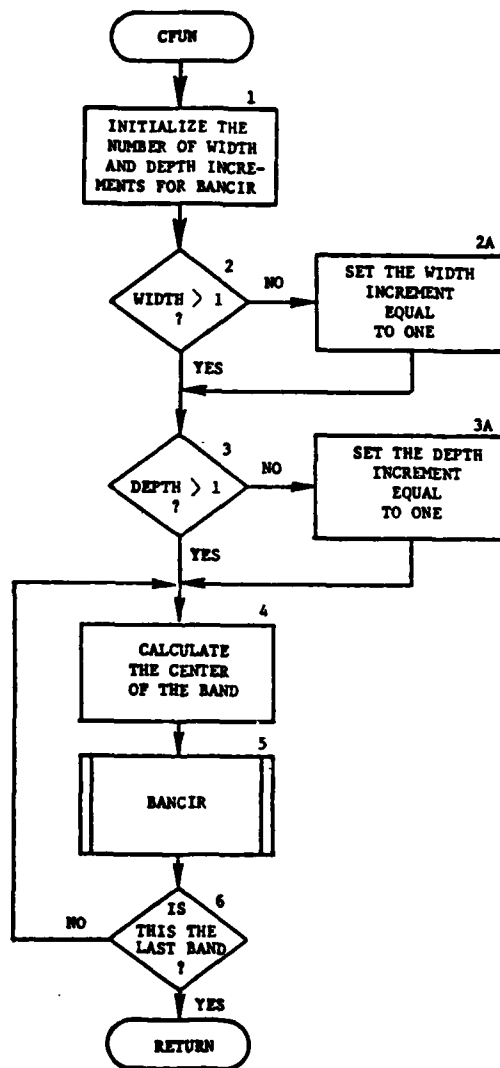


Figure IV-12-B-15. Routine CFUN

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(8) Block 6. If this is not the last band, control goes to block 4.

20. ROUTINE BANCIR:

a. Purpose. BANCIR gives an approximation of the area of overlap between a rectangle and a circle by dividing the rectangle into smaller rectangles, and summing the areas of these smaller rectangles of which center points fall within the circle.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
XI	Call	X coordinates of the center of the circle.
YI	Call	Y coordinates of the center of the circle.
DR	Call	Radius of the circle.
XU	Call	X coordinates of the center of the rectangle.
YU	Call	Y coordinates of the center of the rectangle.
BD	Call	Depth of the rectangle.
BW	Call	Width of the rectangle.
ORENT	Call	Orientation angle of the rectangle in radians.
IX	Call	Number of width increments.
IY	Call	Number of depth increments.

c. Output Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
BANCIR	Call	The area of overlap between the rectangle and the circle.

d. Logical Flow (Figure IV-12-B-16):

- (1) Block 1. Calculate the length of the increments for width and depth, relative to the rectangle.
- (2) Block 2. Calculate the distances (X and Y relative to the rectangle) from the center of the rectangle to the starting point.
- (3) Block 3. Calculate the sine and cosine of orientation angle, and zero the area.

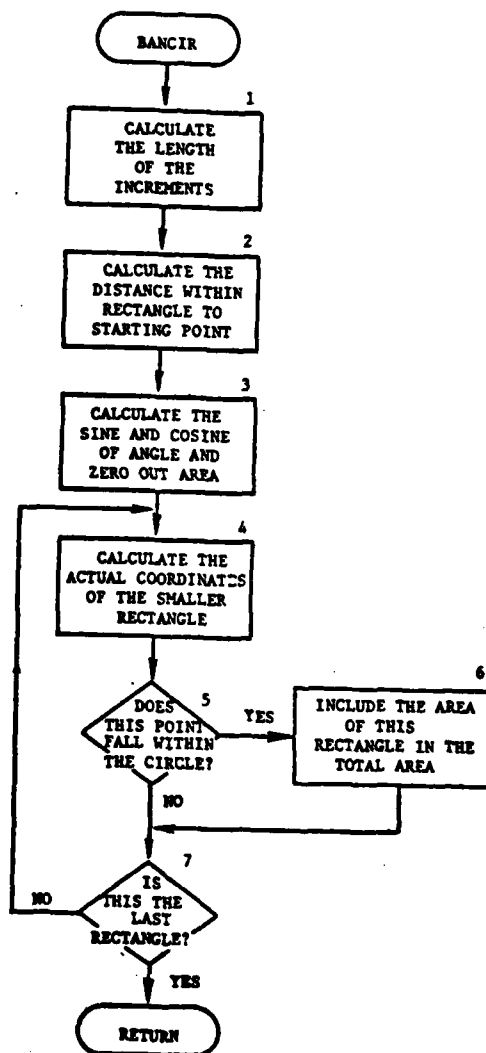


Figure IV-12-B-16. Routine BANCIR

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(4) Block 4. Calculate the actual coordinates of the center of the smaller rectangle.

(5) Block 5. If the center of this smaller rectangle does not fall within the circle, control goes to block 7.

(6) Block 6. Include the center of the smaller rectangle in the total overlapping area.

(7) Block 7. If this is not the last smaller rectangle, control goes to block 4.

21. ROUTINE NBARAS:

a. Purpose. NBARAS assesses existing barriers against the damage radii of the blast or updates the radiation radii of nuclear barriers.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
AGZX	TWO	X coordinate of actual ground zero.
AGZY	TWO	Y coordinate of actual ground zero.
IDUM	DF36	Common variables for Nuclear Assessment Model.
IFIRER	TWO	Force indicator of the firing unit.
RTV(10)	TWO	Radiation factors for radii calculations.
IOF(35)	TWO	Barrier records.
IARRAY(800)	TWO	Array of pointers to barrier records.
IMAX	Call	Total number of pointers in IARRAY.
FILE12(35)	TWO	Event description record.
		FILE12(11). IUID of the unit to assess.
		FILE12(12). Code for calling routine.
		FILE12(13). Casualties to be assessed for the unit.
		FILE12(14). Percent of fatal casualties.
		FILE12(15). Percent of suppressed casualties.

<u>Name</u>	<u>Source</u>	<u>Contents</u>
		FILE12(16). The 2-rad-per-hour radiation radius.
		FILE12(17). The 20-rad-per-hour radiation radius.
		FILE12(18). The 50-rad-per-hour radiation radius.
		FILE12(19). X coordinate of the actual ground zero.
		FILE12(21). Y coordinate of the actual ground zero.
		FILE12(23). Record number of barrier to update (zero indicates all barriers).
NOBFAC(30)	DF30	Character codes for barriers.
NOBFPT(30)	DF30	Pointers to damage radii for the barriers.

c. Output Variables. FILE12 and IOF listed as input (paragraph b above).

d. Logical Flow (Figure IV-12-B-17):

(1) Block 1. If the task is not to assess barriers, but to update nuclear barrier radii, control goes to block L1.

(2) Block 2. Bring in IDUM from data file 36 and get IMAX, the number of barriers in the damage area, and IARRAY, the list of record numbers of these barriers.

(3) Block 3. Bring in the record of the next barrier in IARRAY and the associated pointers to damage radii.

(4) Block L5. Set up the arguments and call CFUN to compute the area of the barrier covered by the damage radius.

(5) Block 4. If no more than half the area of the barrier was in the damage radius, control goes to block 7.

(6) Block 5. If the barrier is damaged, it is destroyed unless it is a forest or minefield. If it is a forest, trees are on fire or are blown down. If it is a minefield, the density of the field is decreased one level. A new barrier is created in the case of forests, and with the exception of minefields, the old barrier record switch is turned off.

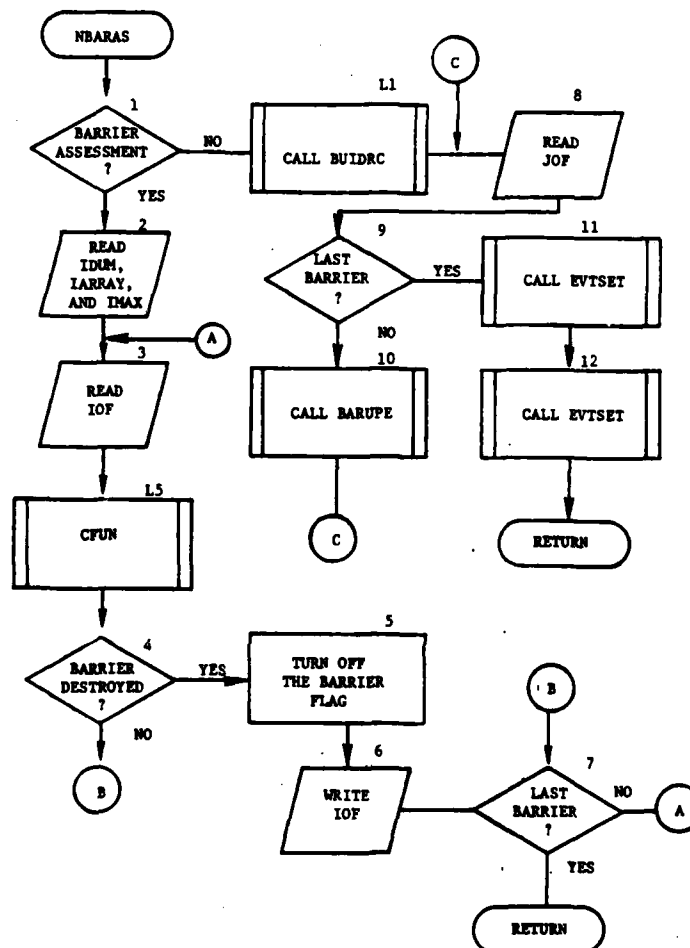


Figure IV-12-B-17. Routine NBARAS

- (7) Block 6. The updated barrier record is replaced.
- (8) Block 7. If this was not the last barrier, control goes to block 3. If it was, return control to the calling routine.
- (9) Block L1. Call BUIDRC to get the location of the first nuclear record.
- (10) Block 8. Bring in the barrier record of the nuclear barrier.
- (11) Block 9. If this was the last barrier, control goes to block 11.
- (12) Block 10. Call BARUPE to reset the radiation radii around this nuclear barrier. Transfer control to block 8.
- (13) Block 11. Call EVTSET to schedule a call to the Engineer Model for updating changes made to these barriers.
- (14) Block 12. Call EVTSET to schedule a call in 1 hour for further updating of these barriers by NBARAS. Return control to the calling routine.

22. ROUTINE BARUPE:

a. Purpose. BARUPE decays the radiation radii around a nuclear barrier as a function of time from the creation of the barrier. When the radius of the 2-rad-per-hour area is less than the height of burst of the round, the barrier is deleted from the barrier file. When the other radii are less than the height of burst, they are set to zero.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IRECR	Call	Record number of the barrier record.
TCLOCK	Call	Present time in this period.
IOF(35)	TWO	Barrier record of the barrier.
R1		IOF(21). The 2-rad-per-hour radius.
R2		IOF(23). The 20-rad-per-hour radius.
R3		IOF(25). The 50-rad-per-hour radius.
AHOB		IOF(24). The height of burst of the round.
		IOF(22). Time the barrier was created.

c. Output Variables. IOF, listed as input (paragraph b above).

d. Logical Flow (Figure IV-12-B-18):

(1) Block 1. Compute the update factor as a function of time and the existing radiation radii.

(2) Block L7. Use the update factor and existing radiation radii to compute the new radii.

(3) Block 2. If the 2-rad-per-hour radius is less than the height of burst of the round, control goes to block 3.

(4) Block 4. Return the updated barrier record, and return control to the calling routine.

(5) Block 3. Turn the barrier switch off. Control goes to block 4.

23. ROUTINE BARNUM:

a. Purpose. BARNUM locates a vacant barrier record of the type designated in the calling parameter. If there are no more of this type, BARNUM searches for a vacant record of the alternate type. The two types of barriers are forest fires and blown down forests. BARNUM returns the new barrier code and its location on data file 2. If there were no blank records of either type, BARNUM returns a negative one value.

b. Input Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
BBID	Call	Character code for type of barrier to be created.
DUID	DF2	Barrier character code of barrier on data file 2.

c. Output Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
IRECNM	Call	Record number of the new barrier.
BBID	Call	Character code for type of barrier created.

d. Logical Flow (Figure IV-12-B-19):

(1) Block 1. Call BUIDRC to get the first location of the barrier of the type specified.

(2) Block 2. Bring in the barrier code of the next barrier.

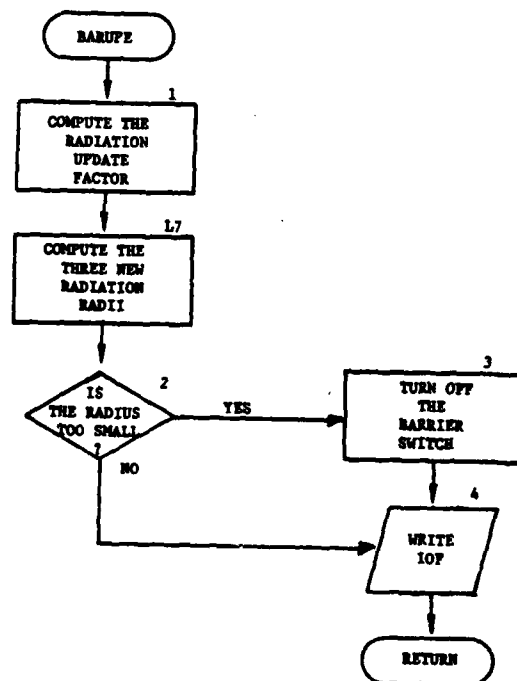


Figure IV-12-B-18. Routine BARUPE

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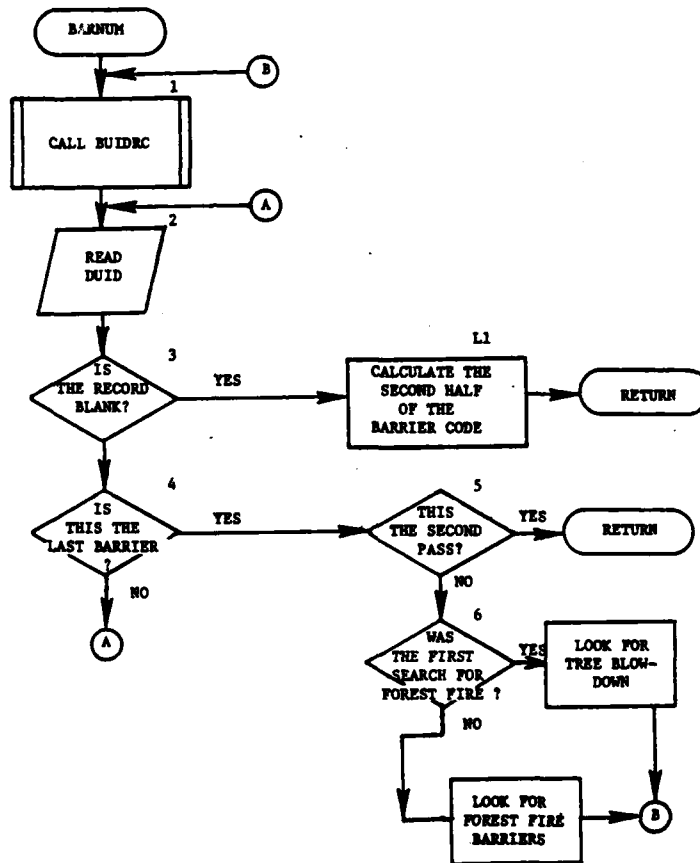


Figure IV-12-B-19. Routine BARNUM

(3) Block 3. If this is a blank record, control goes to block L1.

(4) Block 4. If this is not the last barrier, control goes to block 2.

(5) Block 5. If this was the second pass through the routine, set a flag indicating there are no blank records and return control to the calling routine.

(6) Block 6. Begin search for the alternate type barrier, and transfer control to block 1.

(7) Block L1. Calculate the second half of the barrier character code and return control to the calling routine.

24. ROUTINE NCUNIT:

a. Purpose. This routine deletes personnel from a unit due to radiation or releases personnel back to a unit. Personnel released are those that have been suppressed due to the effects of radiation.

b. Input Variables:

(1) Standard Common Block Area. UCOOP.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
FILE12(35)	TWO	Event description record.
CAS		FILE12(13). The number of casualties for this unit.
PDIE		FILE12(14). The percent of fatal casualties.
PREL		FILE12(15). The percent of casualties to be released.
		FILE12(12). Indicator of release or delete function of NCUNIT.
		FILE12(11). Unit number of unit to be as assessed.

c. Output Variables. Standard common block area, UCOOP.

d. Logical Flow (Figure IV-12-B-20):

(1) Block 1. Bring in the unit status record of the unit to be assessed according to FILE12(11).

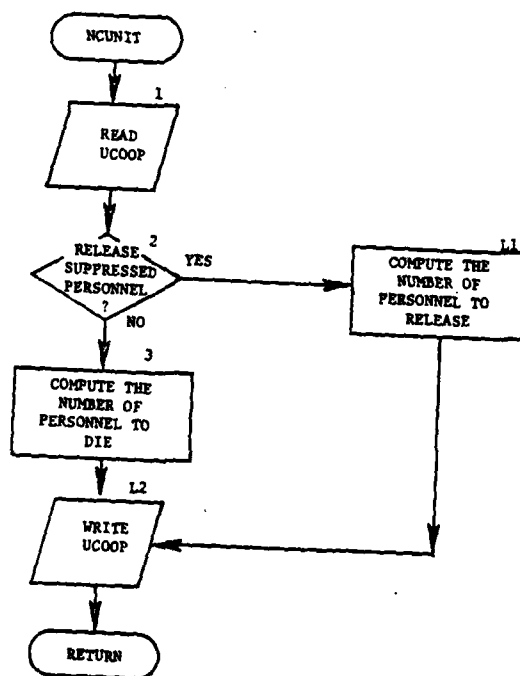


Figure IV-12-B-20. Routine NCUNIT

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(2) Block 2. If NCUNIT is to release suppressed personnel, control goes to block L1.

(3) Block 3. Compute the number of personnel fatalities and delete them from the unit strength.

(4) Block L2. Replace the updated unit status record of the unit assessed. Return control to the calling routine.

(5) Block L1. Compute the number of personnel to be released and add them to the unit strength; then, control goes to block L2.

25. ROUTINE BAMUNT:

a. Purpose. BAMUNT determines the percent of personnel in a unit to receive radiation. It is called when a unit decides to force a nuclear barrier. When enough radiation is received by a unit, BAMUNT decides the percent fatal and the percent suppressed.

b. Input Variables:

(1) Standard Common Block Area. UCOOP.

(2) Other Variables:

<u>Name</u>	<u>Source</u>	<u>Contents</u>
IOF(35)	DF2	Barrier record of a nuclear barrier. IOF(21). The 2-rad-per-hour radius. IOF(23). The 20-rad-per-hour radius. IOF(25). The 50-rad-per-hour radius.
AHOB		IOF(24). Height of burst of the round.
FILE12(35)	TWO	Array of information about the unit to be assessed.
AGZX		FILE12(19). X coordinate of ground zero.
AGZY		FILE12(21). Y coordinate of ground zero.

c. Output Variables:

(1) Standard Common Block Variable. UCOOP.

(2) Other Variables:

<u>Name</u>	<u>Destination</u>	<u>Contents</u>
IOF(35)	DF2	Updated barrier record of a nuclear barrier.

<u>Name</u>	<u>Source</u>	<u>Contents</u>
FILE12(35)	TWO	Array of information about the unit assessed.

d. Logical Flow (Figure IV-12-B-21):

(1) Block 1. Bring in the unit status record of the unit going through the nuclear barrier.

(2) Block 2. Compute the location the unit is to assume for radiation assessment.

(3) Block 3. If none of the three radiation radii overlap a part of the unit, return control to the calling routine.

(4) Block 4. Call CFUN to compute the area of the unit covered by the radiation radius.

(5) Block 5. Compute the percent of personnel that will receive radiation and the dose they will receive.

(6) Block 6. Call BARUPE to update the radiation radii.

(7) Block 7. Update the unit history record with the new doses of radiation and percents of personnel receiving these doses.

(8) Block 8. If there are no personnel receiving enough radiation to be suppressed or killed, return control to the calling routine.

(9) Block 9. If some personnel are to be assessed, call EVTSET to schedule event for the unit to lose personnel. Return control to the calling routine.

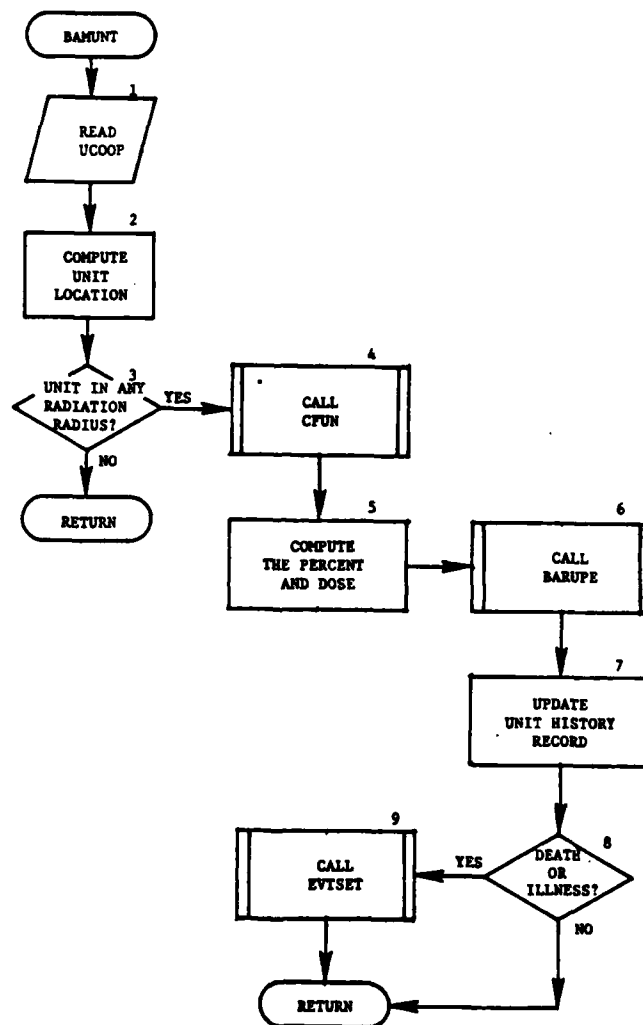


Figure IV-12-B-21. Routine BAMUNT

APPENDIX C

NUCLEAR ASSESSMENT MODEL OUTPUT DESCRIPTIONS

1. INTRODUCTION. This appendix contains detailed descriptions of printed output from routines within the Nuclear Assessment Model of the Period Processor. A figure depicts the format of the printout of each routine. In the figure or alphabetical character (descriptor) designates an appropriate line, group of lines, or column that is explained in the following paragraphs.

2. ROUTINE NFIRE (FIGURE IV-12-C-1). NFIRE, simulates firing a nuclear round and radiation radii.

<u>Output Descriptor</u>	<u>Explanation</u>
A	This message is printed upon entry to the routine NFIRE. It is the first print to be generated by the Nuclear Assessment Model when the model attempts to execute a DSL fire order for a nuclear round. This statement also appears when a call is made to NFIRE to calculate the radiation radii around the blast and to set data file 12 for an engineer event. This is also the last print generated by the Nuclear Assessment Model to execute a nuclear fire order.
B	This line comes from routine NFIRE. The information printed is the unit identification of the unit that is to fire the nuclear round, the impact radius from the DSL order, the height of burst from the DSL order, and the nuclear environment flag.
C	This print is generated by routine NFIRDT. 810 is constant and is a print identifier, the other elements are: <ul style="list-style-type: none">. minimum range for this weapon/warhead from the input data. maximum range for this weapon/warhead from the input data. the distance from the firing unit to the desired ground zero. the X and Y coordinates of the firing unit. the X and Y coordinates of the designated ground zero. a flag equal to eight if a preset height of burst is to be used and equal to nine if the impact radius is to be used. the time required to deliver the round with the unit in state of readiness one.
D	The equipment item codes for the weapon and warhead from routine NFIRE.

*****INTERFERENCE*****									
(A)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(B)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(C)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(D)	801	WEAP AND MAPS	60	14	14	300	70	400	5
(E)	802	AP	60	14	140	500	4000	400	5
(F)	811	VEILD CODE IS F	106984-7577	249-70330	400	1250	770	1100	30
(G)	812	12501-47752	106984-7577	249-70330	400	1250	770	1100	30
(H)	813	12501-47752	106984-7577	249-70330	400	1250	770	1100	30
(I)	815	FROM WRO.	1994	1232	714	957	426	1115	634
(J)	816	FROM WRO.	2400	1500	1200	600	201	1575	731
(K)	816	FROM WRO.	666	1763	1659	524	259	514	251
(L)	803	805	847	954	955	956	973	374	170
(M)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(N)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(O)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(P)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(Q)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(R)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(S)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(T)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(U)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(V)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(W)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(X)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(Y)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500
(Z)	810	5000-0000	40000-0000	1712-4750	147300-0000	107200-0000	125000-0000	137000-0000	500

Figure IV-12-C-1. Routine NFIRE Output (Continued on Next Page)

966 HAS THESE UNMANNED ITEMS.

Figure IV-12-C-1. Routine NFIRE Output (Continued)

- E Line one contains "902", the print identifier, followed by the fuze data for this weapon/warhead combination (FAYT array from data file 30). Line two contains "902" followed by the array of statistics associated with this weapon/warhead combination (WWSTAT array from data file 30) and the force indicator for the firing unit. This print comes from routine NFIRE.
- F The yield code for this nuclear round, from routine NFIRE.
- G This print comes from routine NFIRE. The print identifier "812" is followed by the X and Y coordinates of the actual ground zero and the actual height of burst. These values will be used in the assessment.
- H This print of the RTABLE array comes from routine NDRD. The array contains the four height of burst and damage radii for each of the 30 final damage radii for this particular yield. This information is from the YDRHOB array from data file 30.
- I This is a print of the 30 final damage radii to be used for this assessment. The print comes from routine NDRD.
- J This "903" print comes from routine NFIRE, and contains the list of IUIDs of the units to be assessed. The model allows a maximum of 150 enemy units followed by a maximum of 50 friendly units.
- K This "814" print comes from routine ASUNIT and contains the unit identification record number of the unit to be assessed.
- L This print comes from routine ASUNIT for nonflying units. The print identifier "815" is followed by the array of distributions of unprotected personnel for this unit, the total number of personnel, the percent of the unit's strength suppressed and a flag indicating the unit's warned or unwarned state.
- M This print comes from routine NASEOH. It contains the area in common between the unit being assessed, for each of the four bands of the unit, and the damage radius indexed in the last column.
- N This print comes from routine NASEOH. It is a list of losses for each equipment item code. It contains all equipment lost due to damage or made inoperative because personnel were lost. Secondary equipment items are not included in this assessment

unless the unit does not have its primary equipment item.

- O This print comes from routine NASEOH and contains the unit identification record number of the unit being assessed, the equipment item code, and the number of these items that were included in the losses because the personnel were lost rather than the equipment item being damaged.
- P This print comes from routine NASPER. It contains the area in common between each band of the unit being assessed and the damage radius indexed in the last column.
- Q This print comes from routine UPRMPT. It contains the unit identification record number of the unit being assessed and the personnel losses for this unit.
- R This print comes from routine UPRMPT. It contains the losses from prompt assessment of all equipment item codes for the unit being assessed.
- S This print comes from routine ASUNIT. It is printed only when a flying unit is to be assessed and contains the links from each equipment item code to damage radii.

3. ROUTINE NBARAS (FIGURE IV-12-C-2). These data are from the barrier assessment portion of the Nuclear Assessment Model.

<u>Output Descriptor</u>	<u>Explanation</u>
A	This line indicates that routine NBARAS was entered.
B	The force indicator for the unit that fired the nuclear round (= 1 for Red force, = 2 for Blue force)
C	The number of barriers found by the Engineer Model for assessment.
D	The barrier code for the barrier to be assessed against the nuclear blast.
E	The area in common between the nuclear blast and the barrier being assessed.
F	The percent of the total area of the barrier covered by the blast and the barrier code.
G	The array pointer for the barrier that was damaged.

A—915 ****NBARAS****
 B—IFIRER = 1
 C—817 IN NBARAS. IMAX= 0
 D—NBARAS BAR-CODE BFX001
 E—NBARAS/AREACOM 116000.00000
 F—820 PERCENT COVERED 52.23 BFX001
 G—916 BARRIER DAMAGED 651
 H—THIS IS TO UPDATE BARRIERS
 I—821 NOW CALL BARUPE
 J—**BARUPE** 5284.0 7092.0 9546.0 4232 5574 7637
 K—917 DEAD BARRIER 651

Figure IV-12-C-2. Routine NBARAS Output

- H This print indicates that routine NBARAS was entered for the purpose of updating barriers by shrinking the radiation radii.
- I This print is generated immediately prior to a call to routine BARUPE which will decay the radiation radii around a nuclear barrier.
- J This print comes from routine BARUPE. It contains the three radiation radii as they were passed to this routine through data file 12 and the three radiation radii after they were decayed by this routine. A unit within these three radii will receive a dosage of 2 rad per hour, 20 rad per hour, or 50 rad per hour. If any of these radii decay to less than or equal to the height of burst of the round, the radii are set equal to zero.
- K This print also comes from routine BARUPE. It contains the pointer to the barrier record for a barrier that has decayed to zero. This occurs when the largest radiation radii (for a dosage of 2 rad per hour) has decayed to less than or equal to the height of burst.

4. ROUTINE NCUNIT (FIGURE IV-12-C-3). This routine deletes personnel from a unit due to radiation or releases personnel back to the unit that were suppressed due to the effects of radiation.

(A)	NCUNIT FOR	258
(B)	BEFORE ASSMT.	500.59000
(C)	AFTER ASSMT.	490.58600
(D)	PEOPLE RELS.	36.42000

Figure IV-12-C-3. Routine NCUNIT Output

<u>Output Descriptor</u>	<u>Explanation</u>
A	This print indicates that the routine NCUNIT was entered. It contains the unit identification record number of the unit to be assessed.
B	This print occurs when this routine is entered for the purpose of deleting personnel due to radiation. It contains the total

number of personnel for the unit being assessed prior to assessment by routine NCUNIT. This total includes suppressed personnel.

C This print also occurs only when personnel are to be deleted. It contains the total number of personnel for the unit being assessed after assessment. This total includes suppressed personnel.

D This print occurs when this routine was entered for the purpose of releasing suppressed personnel back to the unit. It contains the number of personnel released back to the unit being assessed.

5. ROUTINE BAMUNT (FIGURE IV-12-C-4). This routine determines the percent of personnel in a unit that receive radiation. It is called when a unit decides to force a nuclear barrier. When sufficient radiation is received by a unit, this routine decides the percent of personnel to die and the percent of personnel to be suppressed.

Output
Descriptor

Explanation

- | | |
|---|---|
| A | This print occurs when this routine is entered. It contains the unit identification record number of the unit being assessed. |
| B | BAMUNT calculates the new coordinates for assessment. These coordinates and the unit's width and depth are printed. |
| C | This print contains the percentage of the assessed unit to receive radiation at the rate of 2 rad per hour, 20 rad per hour, and 50 rad per hour. |
| D | This print appears after a call is made to EVTSET to schedule an event to release the suppressed personnel and another call to EVTSET to schedule an event to delete the fatalities. Included in the print are the total number of personnel in the unit to receive radiation at all three rates, the percent of suppressed personnel that are scheduled to die, and the percent of suppressed personnel that are scheduled to be released. |
| E | This print contains, for each of the three radiation rates, the percent of the unit strength to receive radiation and the number of rads received. It appears prior to the return from this routine. |

(A) — 66	BAMUNT	326					
(B) — 67	BAMUNT	92826.1842	80463.7293	400.0	400.0		
(C) — 70	BAMUNT	0.3126	0.2624	0.1870			
(D) — CAS/PERS		60.0263	10	80			
(E) — 65	BAMUNT	41	2	36	20	28	50

Figure IV-12-C-4. Routine BAMUNT Sample Printout

APPENDIX D

SOURCE LISTINGS FOR PERIOD PROCESSOR NUCLEAR ASSESSMENT MODEL

(AVAILABLE UNDER SEPARATE COVER)

IV-12-D-1

APPENDIX E

REFERENCES

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